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Engineering News-Record

Erecting falsework for 700-ft. span of the Alaska Railroad Bridge over the Tanana River

Economics of the Activated Sludge Process

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By Lieut.-Col. Frederick Mears, Corps of Engineers

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*
Frank C. Wight, *Managing Editor*

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Look Out for Floods

IN THE eastern section of the country we are reaching the end of one of the snowiest winters on record. Ever since the middle of December snowfall has been an almost daily recurrence and while the individual falls have not been very great the succession of storms and the continuous below freezing temperature have resulted in a snow cover of dangerously great depth. Such a condition does not necessarily mean a flood, but with the proper topographical conditions it is the essential preliminary that transforms an ordinary rainfall into a tremendous runoff—and a flood. It is too late now to do anything to prevent such floods, but those communities subject to such danger may well lay some plans to ameliorate their effect if they do come. Channel obstructions can be looked into, low land occupancies can be warned and snow surveys can be made—all with an eye toward a possible sudden warm spell and rain. Fighting a flood means organization, and there is still time to prepare such an organization for a contingency which this year in many places is greater than for a number of years.

A New Professional Activity

A REMARKABLE testimony to the growing importance of the technical society is the recent appointment by the Dwight P. Robinson Co. of a consulting engineer to represent that engineering company on the various technical committees in whose activities it is interested. Cloyd M. Chapman, an engineer with long experience in committee work, has been retained by the firm, if not entirely, certainly in a large measure for that purpose. Such committees have multiplied in late years to a point when large organizations, whether manufacturing, engineering or governmental, have to contribute in the aggregate time of their employees no little money and effort to their work. Occasionally there are heard complaints that such expenditure is wasted, but in the main this is unfair criticism. For the most part these committees are doing excellent work which would not otherwise be done in furthering the study and practice of engineering. Providing the organization has sufficient singleness of scope to make it possible to find one man who can represent it on the committees where it should have representation, the method initiated by the Robinson company gives promise of increased benefit both to the company and the committees.

Winter Stockpiling

DESPITE the embargoes on cement shipments and on open top cars for sand and stone it should be the object of every construction operation and particularly of every contractor for road construction to accumulate on the ground by every means as large a stock as possible of these materials. There will be no extensive release of cars from handling coal by the time the road-building season begins nor is this particular call for cars likely to diminish much during the summer. Dealers, who, most of the winter, have been delivering coal to consumers directly from the cars, will set to work to stock their yards, and consumers chastened by a winter of denial and deprivation in their customary supply will fill their bins well ahead of time. It is not only a possibility but almost a certainty that there will be all through this year and particularly in the latter half of the construction season a shortage of cars for construction materials. Last year, state highway programs were curtailed, many construction operations were extended over the winter into another season and many contractors suffered crippling losses because an unprepared-for railway-transportation shortage developed. Poor rail deliveries last year lost more time for highway builders than any other cause of delay. The figures collected in Iowa by the highway department on lost time on 20 contracts in 1922 show that one-fourth of the total was due to shortage of material. Winter stockpiling is not the simple task for the contractor that some of its loudest advocates seem to assume but with state highway officials allowing estimates on material in stock it is more simple than it was and contractors have no call to complain next summer of material shortage unless they have given the possibilities of winter accumulation and storage fair consideration.

A Real Gasoline Tax

MOTORISTS and automobile associations who are flooding the country with protests that proposed gasoline taxes of 1 and 2c. a gallon are confiscatory of property and subversive of human liberties will do well to contemplate the plan of the Roads Department of the Ministry of Transport in Great Britain to impose a tax of 8c. a gallon, as noted in a letter to the editor in this issue. Britain has some 500,000 automobiles and 350,000 motor cycles and has been taxing them on the basis of horsepower. It is interesting to note from the English press that the change to a gasoline tax plus a flat license fee of nominal amount is being generally urged by the large English associations of automobiles.

Incompetence Unrestrained

LAST week a building that was being erected in New York City by a real-estate man who undertook to be his own contractor and superintendent collapsed during construction, fortunately without killing or maiming any one. The owner-contractor directed or permitted some laborers to undermine a wall—an instance of just the sort of thing that is likely to happen at almost any time when incompetent men are permitted to build. This latter evil is at the root of all the troubles that surround building, so far as public safety is involved. Current practice permits any one to build. He may be a barber or an insurance agent, innocent of all knowledge of the technicalities of building, of archi-

tecture building craftmanship or engineering. Building inevitably involves hazards; it is difficult work and requires skill and care. Only trained, competent men should be allowed to undertake it, if building is to be on a sound basis. Bad building menaces not only the owner's pocket but human life, the safety of every one in the community. Yet we persist in our slip-shod system, vaguely hoping that the individual men who labor on the building will bring about a safe and proper result regardless of ignorant, incompetent, and often vicious direction. The way out is simple, though some hard fighting may be necessary to bring about its practical realization. Skill and competence being required in building just as much as in a surgeon's cataract operation, its practice should be restricted to those who are competent; and the barber, whom the law restrains from undertaking a cataract operation, should in the same way be restrained from building. In the meantime it is profitable to reflect on the long-standing troublesome question of what we are to do about the professional man who sells plans, knowing that they are quite likely to be used by incompetents and that public danger will result. Are we to regard him as a silent accessory to the crime of unsafe building? Or is he merely the helpless victim of a defective system which the public tolerates?

Making Sewerage a Utility

HERE and there throughout the country municipalities have permitted private companies to construct and operate sewerage systems and charge householders for the removal and disposal of the sewage. Seldom has this been done in places of any size, the most notable exception being Atlantic City, N. J. Rarely has a city proposed to make an annual charge for the use of sewers, although there are instances of this on record and such a charge is included in the carefully worked out financial plan under which the Sanitary & Suburban District of Washington, D. C., is building water-works and sewers. Last week it was suggested in these columns that in view of the financial difficulties under which many Ohio cities are operating, possibly it might be advisable for some of them to charge householders for garbage collection. In our news section this week appears an item outlining a bill authorizing the cities and villages of Ohio to make annual charges for the use of sewerage systems, the object being to provide funds for the entire cost of sewage collection and disposal, including capital charges, maintenance, and operating expenses. The bill is sponsored by the Ohio State Department of Health and it is said that it is receiving favorable consideration from the municipalities of the state. Under conditions now prevailing in so many Ohio municipalities, it may be that something of this sort is very desirable as regards both the sewerage and garbage services. In both cases the plan should be regarded as an emergency measure, rather than as ideal—although there is something to be said for this method of financing both services wherever it meets with general public approval and will not materially deter householders from having their sewage and their garbage promptly removed from their premises. Such a plan as related to either service should be accompanied by regulations compelling householders to avail themselves of the sewage and garbage removal facilities offered by the municipality.

Thinking Through on State Water Power

GOVERNOR SMITH of New York continues his pre-election campaign for a state owned water-power development in a message to the Legislature advocating the passage of laws intended to lead to that end. The message, except in one particular, is vague, and that vagueness is communicated to the people of the state, if the tone of the newspaper editorials commenting on the message can be taken as a criterion. If the Legislature of the State of New York is to decide the policy of the state, some one should proceed to educate that Legislature or at least to educate the people of the state so that they could influence the Legislature to think straight on this matter of state owned water power.

The Governor in his message is sure of one thing; that is, that the controversy between the state and the federal government as to ownership and control of border streams must be settled in the state's favor before any worth-while state development can be started. Beyond that, which is an obvious fact, he contents himself with some generalities of the potentialities of water power, particularly on the Niagara and the St. Lawrence, an implication of undue profits by the existing power companies with the concomitant prediction of cheaper power under state ownership, and a recommendation for the immediate repeal of the existing power act. He offers no suggestion that of the 3,400,000 potential horsepower in the state quite half lies in the border rivers over which the state's future control is, to say the least, doubtful, or that the cost of developing those powers, even though the state be granted control, would run well toward $200,000,000. Power cannot be taken out of the Niagara or the St. Lawrence in small units; the very nature of the rivers requires a comprehensive project involving, unless treaty revisions permit more draft above the Falls, huge dams, and the cost of the whole project would be prohibitive unless charged against the total horsepower possible to develop. By the same token, a large part of the interior development requires river regulation over extensive districts and the construction of numerous control dams, all running into money and requiring maximum use. In other words, it is not possible for the state to enter this water-power ownership slowly or in small amounts, except by the development of little streams whose influence on the power shortage would be negligible.

The Legislature is thus confronted with a much more practical problem than the Governor's message would indicate or than the people of the state seem to appreciate. It must prepare a bill which, if enacted, will commit the state to the expenditure of hundreds of millions of dollars (a similar law defeated last November in California authorized a maximum of half a billion) and to the ultimate purchase of all the power developments and transmission projects in the state. Such a law would put the State of New York into a huge and complicated business with ramifications into politics only too well shown by the history of the Canadian province just across the international river. To recommend the state control of power is one thing; to put before the people the actual text of a law insuring such ownership is another and a much more serious thing.

It will be time enough when such a bill is presented to discuss its possibilities. Just now some one should remind the people of New York that the rapacious private power company is a myth in their state, that the

border rivers are not being developed more because of international difficulties, that incidentally would continue to exist under state control, than because of any defect in the current law or neglect on the part of the proper financial interests, and that the interior rivers require for proper utilization extended reservoir control which probably only a state can give. If New York would study Quebec for a proper water-power policy, instead of Ontario, it would find that it is possible for the state to assume complete control of power development and rates with privately owned power companies manufacturing and distributing power developed on rivers whose constant flow, in so far as nature permits, is guaranteed by the state by the construction and maintenance of proper dams and reservoirs. This is a legitimate and successful state function, free from the dangers of public ownership on the scale that state owned water powers inevitably assume. It would work in New York regardless of how the question of state rights in the border rivers is settled and if properly administered would result in a maximum development of the magnificent water powers of the state to the ultimate pecuniary benefit of the people of the state.

Irrigation and the Settler

HOW can irrigation projects be financed, developed and managed so as to be most attractive to settlers? This is a leading question in the West, particularly in arid regions where the problem of getting settlers on the land is almost wholly an irrigation problem. The present situation must be remedied speedily if the further reclamation of irrigable land is to succeed on a large scale and become a permanent factor in American agricultural development. Methods of interesting desirable settlers and helping them to get started on the land must be studied and applied continually, but outstanding above other needs is the fundamental requirement that prospective settlers be told frankly what it will cost, over and above the charges for developing water, to bring the land into production. Unless each settler knows the facts in this regard and has such financial or other help as may be necessary in his individual case, to make his tract of land profitably productive, it is worse than useless to develop water for irrigation and throw land open for settlement.

Optimism still prevails in some quarters, but more often emphatic assertion is made that, since a sufficient number of settlers cannot be secured for projects already under way, further developments are not justified until conditions change. An analysis of the reasons for this latter viewpoint leads to a comparison of the kind of development work done on the various projects. Projects on which the preliminary work has been very complete will find favor when others will not. On the Durham and Delhi colonies in California, for example, where every preparation is made for the settler before he comes to the land, there has been very rapid settlement. The insistent demand now is for land on which the man with very limited capital has a chance to succeed. The major portion of land settlement under present conditions will be made by men of this class and henceforth those projects which offer the most complete preliminary development have the best chance for success.

Formerly the real problem was that of financing the project as a whole. Now the situation has changed and the chief problem is means of financing the individual settler. Colonization ventures are generally admitted to be a desirable means of meeting the present problem and that general feeling has been strengthened by the success of Dr. Mead's experimental colonies in California (see *Engineering News-Record*, Dec. 5, 1918, p. 1015; also an abstract of the annual report of the California Land Settlement Division, elsewhere in this issue). Unfortunately the cost of such undertakings puts them beyond the reach of the thinly populated arid territory that must raise funds for its own development and there is thus also a need for some less expensive method that can be applied in the poorer and less productive regions.

Two points on which it is necessary to safeguard the present day project are (1) some means of controlling the maximum price of land in the area being brought under irrigation and (2) a fixed limit on the maximum amount of land that any individual may hold. Several western states now require that owners of a large percentage of the lands which it is proposed to form into an irrigation district agree on a maximum unit price before the state will guarantee bonds or otherwise lend its support. This does away with the speculation in and exploiting of the newly developed tracts. The economic limit on the amount of land each man may hold varies of course with the class of crops that can profitably be raised. The limitation should be suited to local conditions so as to allow the individual to hold as much land as he can use but no more. These two safeguards are comparatively easy to provide for on federal or state arid projects; otherwise they present obvious difficulties.

On land suitable for coarse foods only (grains, hay, alfalfa, etc.) some Western bond brokers are willing to handle only projects whose development charges are less than $60 to $75 per acre, arranged to be paid off in ten to twenty years. Others favor development costs up to $150 per acre or more, allowing the assessments to extend over a period of twenty-five to fifty years. In support of this latter plan it is argued that this makes possible development of tracts that could not otherwise be used, and that long-term investments in land backed by government guarantees are safe and desirable securities in which to have capital invested. The argument presented to the settler is that payments on such loans do not constitute cause for worry, as a mortgage might, because the development loan is to be considered as a sort of silent partner in the enterprise; a partner on whose account payments would be made annually just as taxes are paid. From the economic point of view this is sound logic because it is fair that several successive owners of the land should each pay part of the cost of the initial development from which all benefit.

Certain general conclusions may be laid down in the formulation of a program on which all interests could unite in the endeavor to improve the present status of settlement and irrigation. (1) Federal aid is needed in the development of arid land on a large scale. (2) Each state should show its good faith and confidence in its own future by co-operating at least to the extent of guaranteeing interest, or in other ways putting state credit back of the better land settlement projects within its own borders. (3) New projects must be developed and equipped as thoroughly as finances permit and then provision must be made for the farmer to get such financial aid as he may need in stocking, equipping and operating his land until it is on a self-sustaining basis.

Bridging the Tanana River on the Alaska Railroad

Ice Conditions Influence Location and Design—Alloy-Steel Pin-Connected 700-Ft. Main Span —Pile Foundations in Deep Gravel—Winter Erection Program

By Frederick Mears
Lieut.-Col., Corps of Engineers, U. S. Army
Chairman and Chief Engineer, Alaskan Engineering Commission

AN EXCEPTIONALLY long truss span which avoids the necessity of channel piers subject to heavy ice pressure and, by being placed at such an elevation as to clear steamers, avoids the undesirable element of a draw span, is the distinctive feature of the bridge now approaching completion to carry the Alaska R.R. across the Tanana River within 56 miles of Fairbanks, the northern objective point of this railroad. Silicon steel is used largely in the main span. The approaches include a riveted truss span of 120 ft., a plate-girder viaduct and a long timber trestle. The site and its southern approach are shown in Fig. 1.

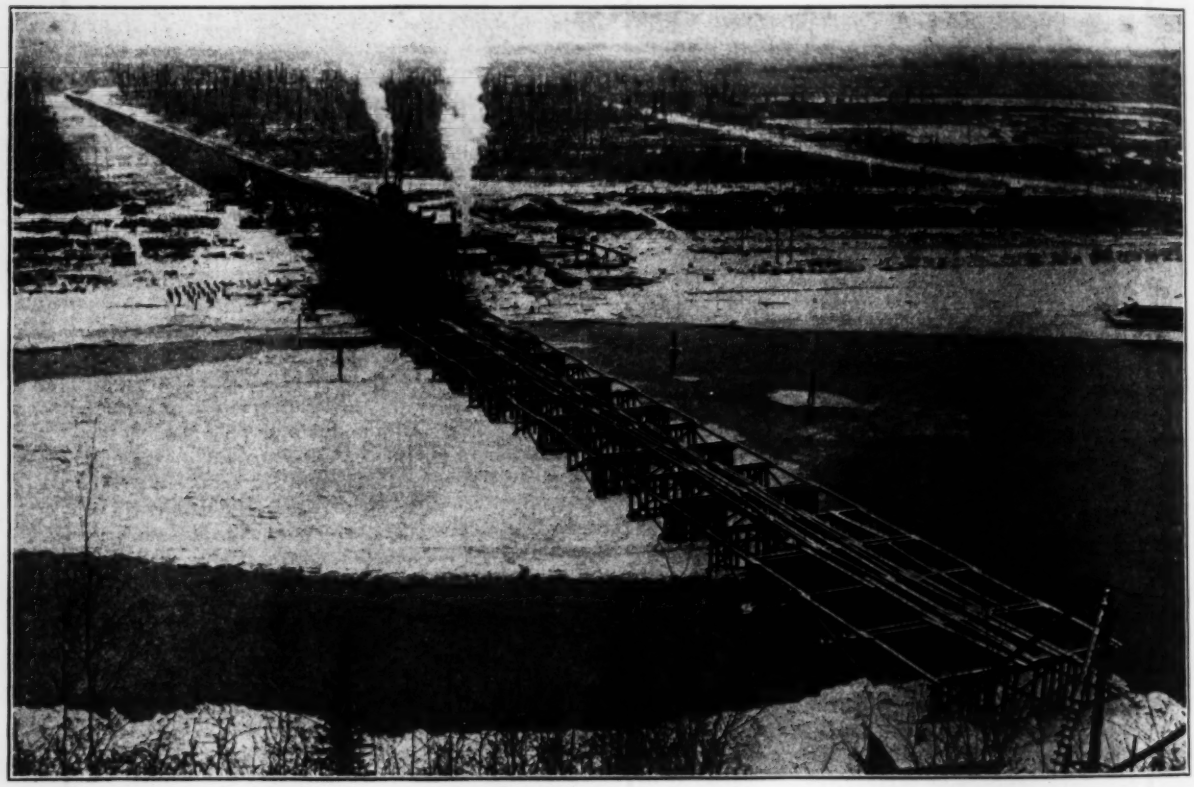


FIG. 1—BUILDING THE TANANA RIVER BRIDGE—ON THE LINE OF THE ALASKA RAILROAD
Lower part of falsework for 700-ft. span is in place. Crane is placing upper bents and floor steel. Approach makes a hairpin curve to reach water front. City of Nenana at extreme right.

The Tanana River has its source in Lat. 62° 30′ N. and Long. 141° 30′ W. near the international boundary line between Alaska and Canada. It flows in a general northwesterly direction through north-central Alaska for about 600 miles to its confluence with the Yukon River near Fort Gibbon and is navigable for about half the distance above its mouth. The Alaska R.R., extending from Seward to Fairbanks, constructed and operated by the United States, crosses the Tanana River near Nenana, a town on the south bank of the river, near the point where the Nenana River enters the Tanana.

Alternative Locations—The crossing of the Tanana River presented a problem calling for careful study in view of the peculiar characteristics of Alaskan glacier streams. Near Fairbanks the river flows over a stream bed about four miles wide from bank to bank, shifting from one channel to another year by year, as it builds up or washes away the glacial deposits. A permanent crossing of the river in these flat sections was considered impractical. The range of hills which closely borders the north bank of the Tanana River below Fairbanks, comes to an abrupt end opposite the town of Nenana, which made it possible to locate the railroad and bridge axis on comparatively level grades leading into the flat lands north of these hills, thus avoiding any heavy cutting across the range. The lower end of these hills, therefore, determined the point of crossing of the Tanana River.

From Mile 371 northward the location of the Alaska R.R. followed the east bank of the Nenana River with long tangents and easy curvature, and the general direction of this line was produced across the Tanana River at Mile 411, as indicated in Fig. 2. Such a location called for a bridge 3,544 ft. in length with five concrete piers and having a movable span to accom-

modate river steamers. The general design for this structure, as prepared by W. J. H. Fogelstrom, former bridge engineer of the Alaskan Engineering Commission, called for a 200-ft. steel lift span and two 350-ft. steel truss spans, together with several pony spans and a trestle approach, estimated to cost $1,221,000.

There were serious objections to this location, however, the Tanana River here flows over a bed of sandy soil with no foundation rock available for piers or foundations. The distance from south bank to north bank is 1,600 ft., with an island forming a secondary channel near the north shore. The average depth of water in the main channel is 20 ft. and the current flows at about 4 mi. per hr. The river freezes about the middle of October. Ice 3 to 4 ft. thick is formed during the winter and goes out at the spring breakup about the second week in May.

It was noted that the ice near the lower proposed bridge site invariably moved out in an unbroken mass extending three-fourths the distance from bank to bank and from 1,000 to 2,000 ft. upstream. The ice upstream from the large bend above the town usually jammed against the bluff on the outside curve of the north bank and broke up in this jam before being carried down stream.

In view of the probable effect of the shock and pressure of the great mass of ice upon channel piers built upon pile foundations, this first plan was abandoned as involving risks out of proportion to the requirements of the project. The site finally selected (see Fig. 2) is 4,000 ft. upstream, avoiding the necessity of building piers in the main channel. The estimated cost of the bridge at this site is $1,289,435.

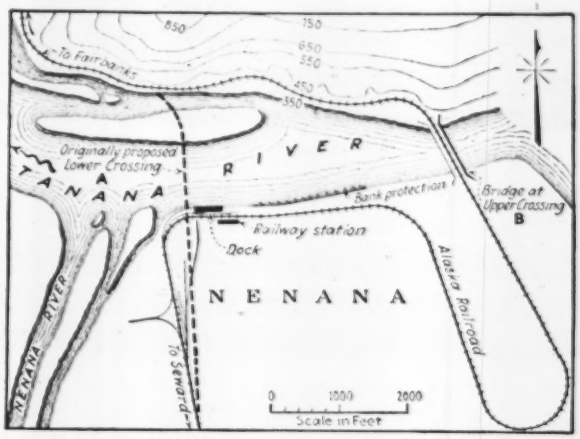


FIG. 2—ALTERNATIVE LOCATIONS FOR TANANA RIVER BRIDGE

Although better alignment, with less rise and fall in grade, and with a saving in distance and avoidance of loop development in the south approach, would be secured by the lower crossing, the apparent advantages and small economies effected by this location would be more than offset by certain objectionable elements: (1) This crossing required a vertical lift bridge which would have to be opened frequently during the summer, necessitating continual expense for maintenance and operation; (2) on account of foundation conditions the cost for all channel piers would be high and, due to the menace from ice jams in the spring breakup, extraordinary precautions would have to be taken in pier design and construction. Furthermore, the original cost estimate for piers might easily be exceeded in actual practice, due to the short summer season and adverse climatic conditions under which this special field work would have to be carried on.

On the other hand, the upper crossing, consisting of a long channel span and suitable approaches, was believed to meet the objections raised against the lower crossing, with no offsetting disadvantages except extra grade, distance and curvature in track approaches. The following points in its favor determined its adoption: (1) Its simple truss span 700 ft. in length, spanning the entire river from shore to shore, did away with the necessity of constructing piers in the main channel; (2) the clearance of 47 ft. above mean summer high water made unnecessary any form of movable span.

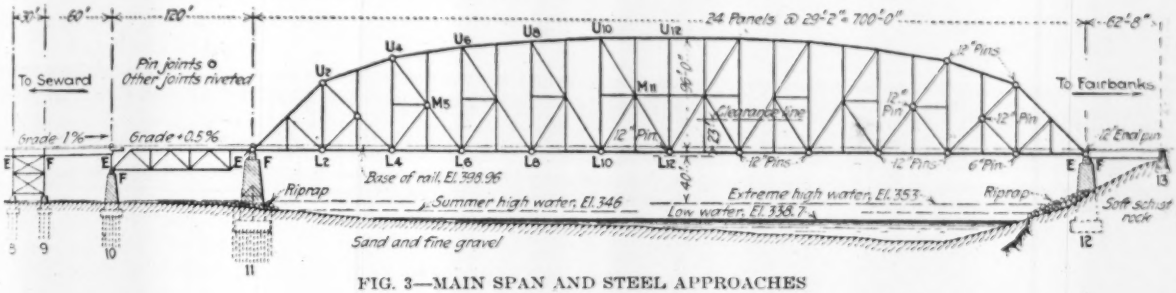


FIG. 3—MAIN SPAN AND STEEL APPROACHES

Topography at Bridge and Approaches — On the adopted location the axis of the bridge is laid across the Tanana River at its narrowest point and just below a sweeping bend where the force of the current is thrown against the bluffs of the Tortella Hills. Below the crossing, the river widens out in front of the town of Nenana. Above the bridge site the left bank of the river is low bottom land and considerable bank erosion has been going on, so that for about a mile this south or left-hand bank will require protection by heavy rock rip-rap to prevent erosion of the railroad grade.

To retain the main line location through Nenana it was necessary to extend the track up the waterfront parallel to the river bank and loop to the south to make the desired crossing of the river. This had the advantage of putting the station in the heart of the town, which is very desirable in a cold climate. A proposed location provided a 6-mi. cut-off line connecting the bridge tangent with the general alignment along the Nenana River, but while this was a little shorter than the adopted location it had the disadvantage that Nenana would have to be served by a spur track. As a considerable part of the freight tonnage for interior Alaska will be delivered to the river docks at Nenana, for transfer to down-river boats, it was not believed

advisable to divert the main line from the town. The roadbed leading from the north end of the bridge site is benched in on the south slope of the Tortella Hills and connects with the established alignment of the railroad at North Nenana, about one mile from the bridge.

General Description of Bridge—From south to north the bridge will be made up as follows: (1) Pile and frame timber trestle 2,880 ft. 4 in. long, with 14-ft. spans; (2) a steel viaduct consisting of four 30-ft. deck plate-girder tower spans alternated with five 60-ft. deck plate-girder spans; (3) a deck riveted Warren truss span 120 ft. long; (4) a 700-ft. through pin-connected truss span with subdivided panels; (5) a 60-ft. steel deck plate-girder span. This gives a total length of 1,302 ft. 4 in. for steel and 4,183 ft. for the entire structure. The main span and adjacent steel spans are shown in Fig. 3.

As the War Department required 40-ft. clearance above extreme high water there is a grade of 1 per cent on the long south approach and 0.5 per cent on the smaller truss span. The 700-ft. and north 60-ft. spans are level. Between these grades short vertical curves have been introduced by notching the ties. The entire bridge is on tangent except for 366.2 ft. at the south end of the trestle and 13.7 ft. at the north end.

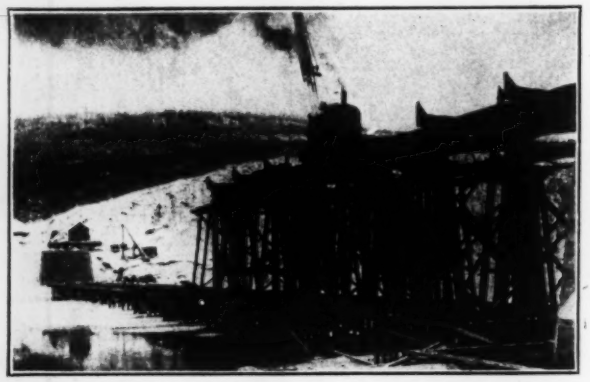


FIG. 4—ERECTING 700-FT. SPAN OVER TANANA RIVER
The lower bents of falsework were placed first to form a crossing. The 100-ton crane then set the upper bents and placed the steel for the floor system.

Foundation Conditions—Fine sandy loam is the soil on the south bank, and 15 ft. below the surface a stratum of sand and fine gravel was tested to a depth of 64 ft. In mid-channel the water is 19 to 33 ft. deep. Since no rock was found within the area covered by Piers 1 to 11, inclusive, pile foundations were designed for these piers. The hills north of the river slope directly to the shore and Pier 12 (at the north shore) was located well back from the water line, as the face of this rocky bluff takes the force of the river current. The rock is of poor quality, being a mica and quartzite schist which disintegrates under the action of the weather. Fortunately the stratification dips into the hill at this point and the pier was constructed on solid rock in an excavation 20 ft. deep below the ground line at river side of pier.

Substructure—Pier 1 was designed for a future pier-abutment. To carry this future pier a concrete foundation resting on 48 untreated spruce piles was constructed, having pedestals to carry a rocker-bent. Piers 2 to 9, inclusive, were built on foundations of nine piles each with an average penetration of 25 ft. Each pier was calculated to carry a combined dead and live load of 17 tons per pile. Pier 10, carrying the south end of the 120-ft. deck span, has 48 spruce piles calculated to carry 22 tons per pile. These pile loads do not allow for intermediate support from the ground.

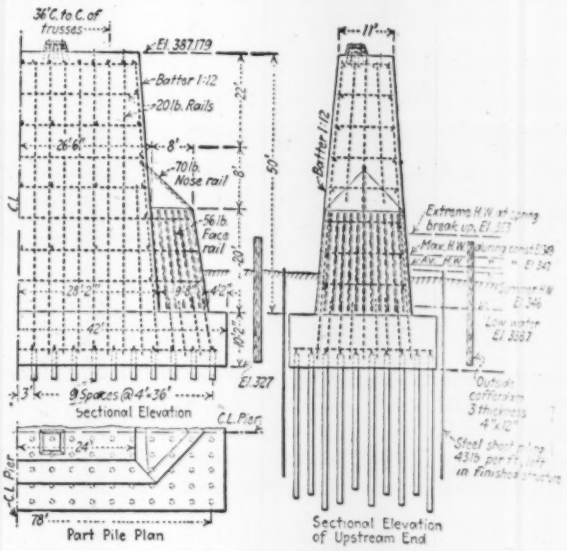


FIG. 5—SOUTH PIER OF CHANNEL SPAN

The important item in substructure construction was the building of Pier 11, carrying the south end of the channel span, shown in Fig. 5. A pile foundation was designed to support a combined dead and live load of 3 tons per square foot on the footing, 30x84 ft. Steel interlocking sheet piling 40 ft. long was used for the cofferdam. At this site the river bed was at El. 345 and high water during construction was at El. 349. In order to get the maximum benefit from the protection of the steel sheeting below the foundation, an auxiliary cofferdam, 44x92½ ft., was made of three-ply wood sheet piling, with its top at El. 352.

This cofferdam was made as watertight as possible and was strengthened by excavating some material from the enclosure and depositing it carefully around the outside of the cofferdam. With a 20-ft. head at the average stage of the river, this method disposed of a great deal of the water and made work easy for the pumps during the operation that followed. The 40-ft. steel piling was then driven inside the enclosure to a uniform depth at El. 306, the top being at El. 346, or 6 ft. below the outside cofferdam and 1 ft. below mean water level.

It was decided to excavate the foundation pit to El. 327, which was 20 ft. below mean water level, 22 ft. below high water level during construction, and 7 ft. above the bed of the stream. It should be noted that the direction of current at this crossing precluded the possibility of any heavy current along the south bank.

Pier Excavation—Removal of the top layer of soil at Pier 11 was done by two skid derricks carrying three-drum steam hoists and operating clamshell buckets. The remainder of the excavation was done by hand, with the use of skips and large bottom-dumping buckets. It was found more economical to remove the gravel and compact layers of soil by hand labor rather than to suffer the delay consequent upon the small output from clamshell and orange-peel buckets. A sump was maintained at the downstream end of the pit and the enclosure was kept unwatered by one 8-in. and one 5-in. pulsometer pump.

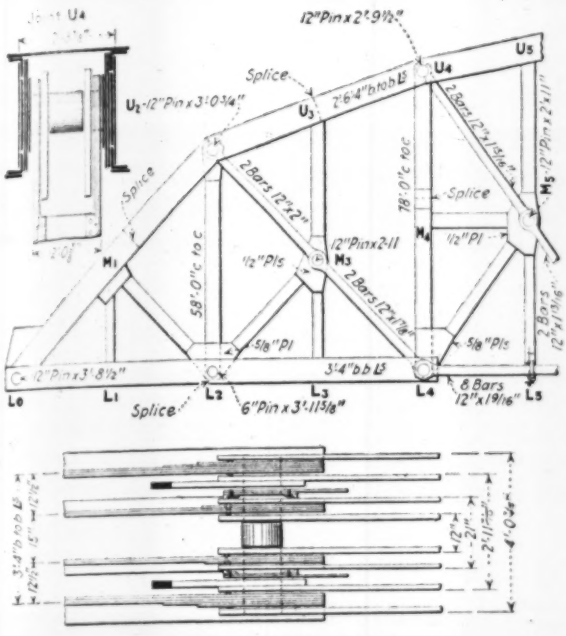


FIG. 6—END PANELS OF 700-FT. TRUSS

A central steam power plant to operate pile drivers, derricks and pumps was built near the pier. This has a 125-hp. marine boiler and a 60-hp. locomotive-type boiler. The excavation of 1,809 cu.yd. for this pier was completed in thirteen days. One pile driver, working on double shift, drove 200 foundation piles with an average penetration of 25 ft. in nine days. Untreated spruce piles of good size were used in all piers and foundations; they will be permanently below water level of seepage water. Piles were jetted into place by means of a 3-in. pipe, 20 ft. long. This foundation was designed to carry 25½ tons per pile after allowing a load of 1 ton per square foot on the gravel between piles.

Gravel concrete of 1:6 mix was used, with 2,560 cu.yd. in pier No. 11. A grillage of old rails was placed on top of the piles and the foundation slab was further reinforced with rails. The pier shafts was reinforced vertically with 20-lb. steel rails near its outer surface, these rails being spaced 3 ft. c. to c., and well bonded into the foundation slab.

Superstructure—Special alloy steels were used in the design of the channel span, which closely followed that of the McKinley bridge over the Mississippi River, at St. Louis. A simple truss span as the main span over the river was obviously the most suitable type for such a crossing. The location of the short piers to clear the ice flow and provide suitable resistance to the undermining action of the river determined the proper length of span to be 700 ft.

The entire steel bridge is designed for a live load of two Cooper's E-50 engines followed by a uniform load of 4,000 lb. per lineal foot of track. Wind load on loaded structure was taken at 30 lb. per square foot on area of train and floor as seen in elevation, with an addition of 30 lb. per square foot on the area of two trusses, eliminating that portion covered by train and floor which was treated as moving load. On the unloaded structure a wind load of 50 lb. per square foot was assumed, acting on the exposed area of two trusses and floor and treated as moving load. Some details of the truss span are shown in Figs. 6 to 9.

Grades of Steel—Freight from the fabricating shop to the bridge site was so large an item that the use of alloy steels was especially attractive. Three kinds of steel were specified and used. Carbon steel is used in part of the viaduct and all of the 120-ft. deck span. Silicon steel is used in the main angles and web plates of the 60-ft. girder spans. In the 700-ft. span nickel steel is used for all eyebars, which are annealed; silicon steel for all main material of both trusses and floor system, pins and large detail parts; and carbon steel for the remainder of the span, including subdiagonals, hangers and small details. Shoes and rollers are of cast steel annealed, and bolsters are of cast iron. The designers furnished complete specifications for mill and shop fabrication. Those covering chemical and physical requirements of the alloy steels are in part as follows:

Nickel Alloy Steel—(Specification for specimen tests)—Nickel alloy steel shall not contain more than the following percentage of elements: Manganese, 0.80; phosphorus, 0.06 in acid steel and 0.04 in basic steel; sulphur, 0.045; silicon, 0.15; carbon, 0.40. In addition, the steel shall contain not less than 1.20 per cent of nickel and may contain such percentage of chromium, vanadium or other metals as may be necessary to meet the physical requirements specified. Material containing more than 3 per cent of nickel may contain up to 0.45 per cent carbon. Whatever composition of alloy steel is selected by the manufacturer, it is essential that the material shall be uniform or approximately of the same composition throughout

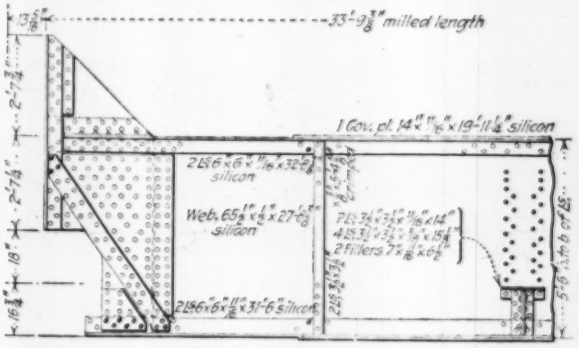

33'-9 3/8" milled length
1 Cov. pl. 14" x 5/8" x 19'-11 1/2" silicon
2 L's 6" x 6" x 11/16" x 32'-6" silicon
Web, 65 1/2" x 1/2" x 27'-6 3/8" silicon
2 Fillers 7" x 1/2" x 6 1/2"
2 L's 6" x 6" x 11/16" x 31'-6" silicon

FIG. 7—INTERMEDIATE FLOORBEAM

Bidders are required, therefore, to submit lower and upper limits of percentage of metals in alloy steel they propose to use. The upper limit in each case shall not be greater than 125 per cent of the lower limit. (The manufacturer agreed to furnish nickel in proportions of 3 to 3.75 per cent.)

Physical requirements for nickel eyebar steel annealed: Ultimate strength, 95,000 to 110,000 lb. per square inch; elastic limit, not less than 55,000; minimum elongation in 8 in., 14 per cent; minimum reduction in area, 25 per cent. Tests of full-size eyebars are required to meet the following specifications: Minimum ultimate strength, 80,000 lb.; minimum elastic limit, 47,000; minimum elongation, 10 per cent, this elongation to be measured in 18 ft. including the fracture.

Silicon Alloy Steel—(Specification for specimen test)—Silicon steel shall contain not more than the following percentages: Manganese, 1.00; phosphorus, 0.06 in acid and 0.04 in basic steel; sulphur, 0.05; carbon, 0.40; silicon, 0.45. The percentage of silicon shall be not less than 0.20. Ultimate strength, 80,000 to 90,000 lb.; elastic limit, not less than 45,000; minimum elongation in 8 in. for material 1 in. thick and less, 1,600,000 divided by ultimate strength; minimum reduction in area for material ¾ in. thick and less, 35 per cent. Certain modifications in elongation and reduction area are permitted for metal thicker than specified above.

Unit Stresses—The unit stresses used in design are:

A. Chords and end posts in compression:

	Alloy	Carbon	
Dead load	28,000	18,000	Top chords of 120-ft. deck span
Live load	14,000	9,000	
Combined (D.L. + L.L. + W)	23,000	16,000	

Least transverse dimension not to be less than $\frac{1}{16}$ of unsupported length. Portion of top cover plate unbalanced by bottom flanges not included in determination of section.

B. All other compression members in trusses:

	Alloy	Carbon
Dead load	$28{,}000 - 112\frac{l}{r}$	$20{,}000 - 80\frac{l}{r}$
Live load	$14{,}000 - 56\frac{l}{r}$	$10{,}000 - 40\frac{l}{r}$

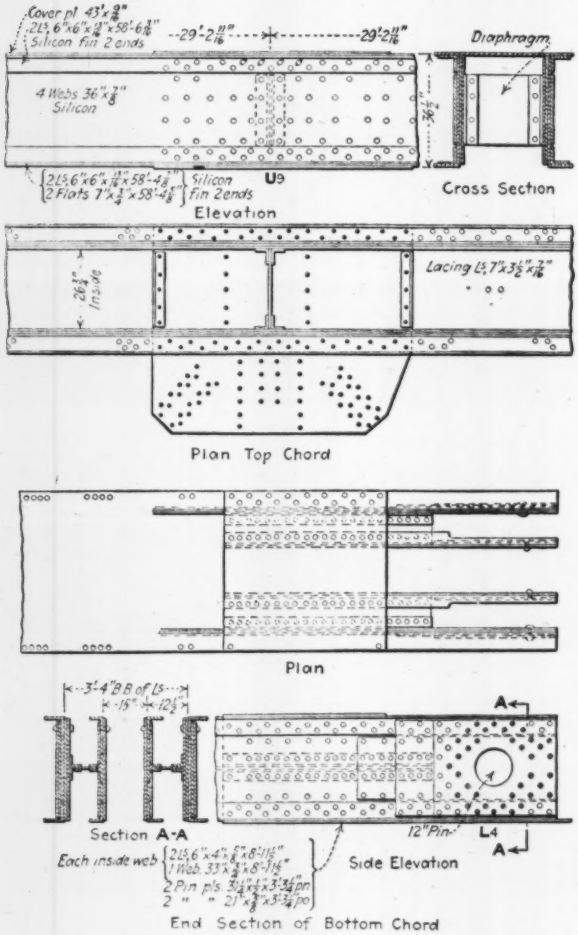


FIG. 8—CHORD DETAILS OF 700-FT. TRUSS

C. All tension members in trusses:

	Alloy	Carbon
Dead load	30,000	20,000
Live load	15,000	10,000
D.L. + L.L. + W	25,000	———

Live-load stresses in main web members to be increased by an excess load stress (E.L.) as noted below in paragraph K. Certain other live-load stresses are increased by an unbalanced load stress, U.L., as given below in paragraph L.

D. Viaduct columns:

	Carbon
Dead load	$20{,}000 - 80\frac{l}{r}$
Live load + traction	$10{,}000 - 40\frac{l}{r}$
D.L. + L.L. + W. + T.	$13{,}000 - 52\frac{l}{r}$

E. Floor beams, stringers and girders:

	Alloy	Carbon
Dead load	30,000	20,000
Live load	15,000	10,000

F. Laterals and sway bracing:

		Alloy	Carbon
Wind on loaded structure	Tension	25,000	18,000
	Compression	$25{,}000 - 100\frac{l}{r}$	$18{,}000 - 72\frac{l}{r}$
Wind on unloaded structure	Tension	25,000	20,000
	Compression	$25{,}000 - 100\frac{l}{r}$	$20{,}000 - 80\frac{l}{r}$

G. Rivets (carbon); no allowance for field rivets:

	Bearing	Shear
Dead load	24,000	12,000
Live load	12,000	6,000
Wind load	20,000	10,000

H. Pins:

	Bearing	Shear	Bending
Alloy			
Dead load	32,000	20,000	36,000
Live load	16,000	10,000	18,000
Carbon			
Dead load	24,000	15,000	26,000
Live load	12,000	7,500	13,000

I. Pressure on masonry.—Dead load, 500 lb. per square inch; live load, 250 lb.

J. Rollers, cast steel.—Dead load, 500 D per lin.in. of roller; live load, 250 D, in which D is diameter in inches.

K. Excess load (E.L.)—Live-load stresses in main truss members (except chords and end posts) shall be increased in the ratio of $\frac{L-d}{L+d}$ per cent, where L is length of span and d is length of loaded portion.

L. Unbalanced load (U.L.)—Live-load stresses in girder spans, floor beams, hangers and sub-diagonals, also viaduct columns, shall increased by $\frac{1}{4}$ (100-L per cent), where L is length of span.

The spacing of the viaduct girders is 8 ft., that of the stringers in the 120-ft. deck span and 700-ft. spans 7 ft., that of the trusses in the 120-ft. deck span 14 ft., and that of the trusses in the 700-ft. span 36 ft. Expansion points are indicated on the plans (see Fig. 3); special expansion is provided for stringers in the 700-ft. span at panel points 8. Both field and shop rivets are $\frac{7}{8}$ in. diameter, except that in the 700-ft. span 1-in. rivets are used in the end posts, top and bottom chords and floorbeam connections to bottom lateral plates. Structural details and sections of interest may be found in Figs. 6 to 9.

Weight of Steel—The weights of steel in various parts of the bridge are tabulated below. For the 700-ft. span the total is 4,761,072 lb. or about 2,380.5 tons. For the entire bridge, 5,563,037 lb. or about 2,781.5 tons. These figures include all steelwork except anchor bolts or deck fastenings:

	Carbon Steel, Lb.	Silicon Steel, Lb.	Nickel Steel, Lb.
Viaduct, 120 ft. deck span and north 60-ft. girder span	613,323	188,632	
700-ft. span	1,956,556	2,010,206	794,310
Total	2,569,889	2,198,838	794,310

The heaviest pieces to handle in the 700-ft. span are the lower sections of the end posts, which weigh 24 tons. End bottom chord sections weigh 22 tons and 20 tons, respectively, and the top chord pieces 21 to 26 tons each.

Erection—Material was delivered at the south end. Steel erection started with placing the viaduct and 120-ft. deck span, all of which were placed from a yard track on the ground with a 100-ton locomotive crane. This erection started Oct. 7, 1922, and was completed Oct. 19. Riveting was started as soon as possible and was completed by the first week of November.

Falsework for the 120-ft. span consisted of framed fir bents resting on mud sills. Falsework for the 700-ft. span was built of framed fir bents resting on pile foundation, as shown in Fig. 1 and Fig. 4. Pile driving for this falsework started Sept. 5, 1922, and was completed a month later, except for bents under the two north panel points, which are framed bents on mud sills.

Erection of framed bents and floor system proceeded from the south end, using the 100-ton locomotive crane to handle material from track on top. At the time of writing, Nov. 25, all falsework and the entire floor system had been placed. It is the intention of the erectors to use the 100-ton locomotive crane for placing the balance of the truss span, supplemented by a lighter crane in the yard assembling material and placing it conveniently for the large crane above to handle. On Nov. 2, seven panels of the floor system had been placed. River ice was bearing against the pile falsework on the upstream side, with but little ice formed below. For safety, the work of placing further falsework and floor system was suspended until the river froze over below the bridge, but this delay was only a few days. Figs. 10 and 11 show the falsework construction for the main span. Double bents are used under main panel points and single bents under sub-panel points.

To provide against overturning the 100-ton crane on the 700-ft. span, four 24-in. 100-lb. I-beams are placed with their ends resting on the floorbeams and as close as possible to the ties to support the crane's outriggers. In placing the end posts and the top chord sections the lifts will be made by the crane with load line attached to a balance beam whose ends are so bolted to the piece handled that the piece will balance properly and also clear the boom of the crane better.

Winter Versus Summer Erection—It is of interest to note that the erection of the main truss will take place during the coldest weather in Alaska, when, for short periods of time, the temperature drops as low as 50 or 60 deg. below zero.

The writer took the responsibility of arranging for winter erection, as it was believed to be the safest plan under the conditions. As the ice goes out of the Tanana River not earlier than May 12, it would be some time in June before falsework could be established across the river, against the current of a spring freshet. This schedule would leave only three months in which to erect the span and swing it clear of the menace of the fall ice-run against the falsework. Furthermore, it was considered that the falsework would be endangered during the summer months should there be one of the big floods which frequently occur, carrying driftwood as large as full-sized green cottonwood trees, with roots and branches intact, which have been swept away by the flood in the process of bank erosion.

As the formation of solid ice is usually complete by the end of October, and the ice remains in place until May, there is available a period of six months in which to erect the bridge and remove falsework, during which period there is no obstacle to steady field work, except the short periods of severe cold weather. During 1921-22 these were so few as to be of no consequence. The good results obtained in carrying on a program of winter erection of a similar structure at the Susitna

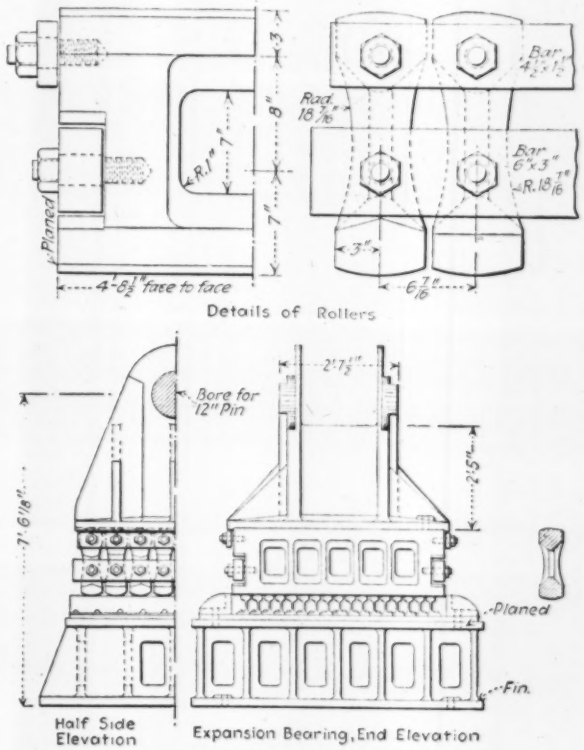


FIG. 9—EXPANSION BEARING AND ROCKERS

River, together with the success that we have already had with the Tanana Bridge, fully confirm the wisdom of the policy in thus handling this bridge project.

Engineering Organization—The field work has been carried on under the personal supervision of the author in the capacity of chief engineer of the Alaskan Engineering Commission, with the following organization: F. A. Hansen, engineer of maintenance and construction, in general charge; F. H. Chapin, bridge engineer; C. G. Jones, superintendent of construction; J. J. Kestly, resident engineer; Jack Hanson, inspector.

The contract for the fabrication and erection of the steel superstructure was let to the American Bridge Co., the field work being carried on by H. M. Braford, foreman of erection, and E. G. Amesbury, assistant engineer. C. S. Garner, manager of foreign erection for the American Bridge Co., has taken a keen interest in this job and it is due to the energy of his persua-

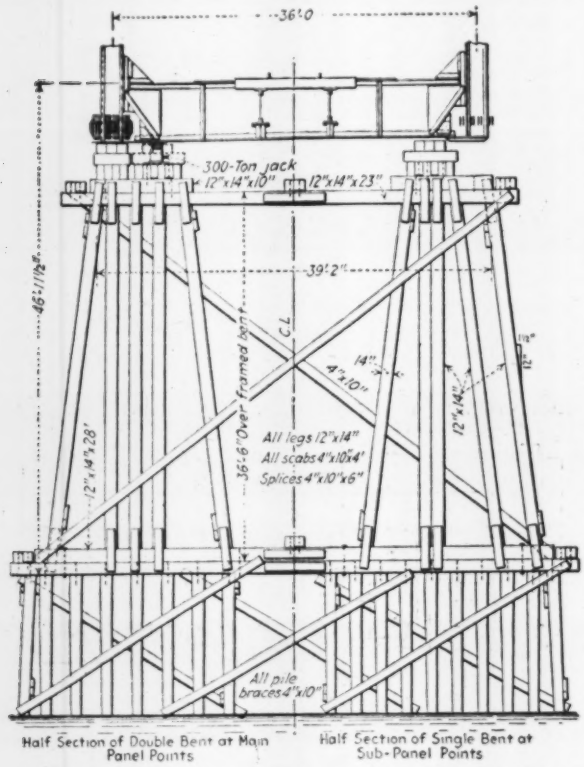


FIG. 10—FALSEWORK BENTS FOR 700-FT. TRUSS SPAN

sion that two full train-loads of steel were moved from Ambridge, Pa., to Seattle, Wash., in the record time of twelve days.

In view of the importance of this bridge in point of cost and physical conditions the U. S. Government retained the firm of Modjeski & Angier, Chicago, as consulting engineers. Mr. Angier visited Alaska in the spring of 1920 and approved the adoption of the upper crossing. This firm was then retained to design the bridge, preparing detail plans for substructure and superstructure and following up the construction of foundations and the steel fabrication. Mr. Angier again visited the job in June, 1922, when foundation work was being started.

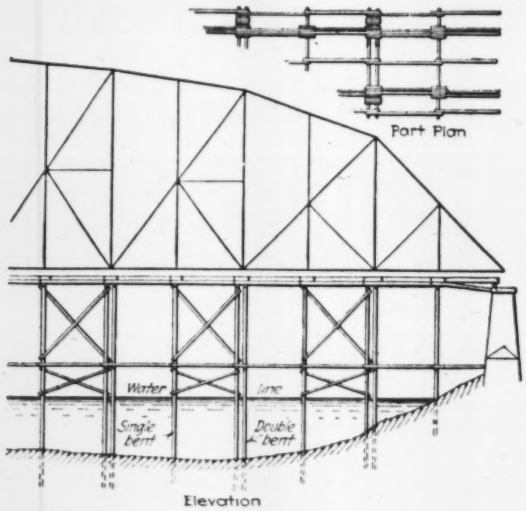


FIG. 11—ARRANGEMENT OF FALSEWORK

Differences Between Heartwood and Sapwood Timber

SAPWOOD is the outer light-colored portion of a tree trunk through which the water passes from the roots to the leaves, and in which excess food is stored temporarily. Heartwood is the central core of the trunk. As new sap is formed on the outside of the tree trunk, the inner sapwood changes to heartwood. During this change the living cells die, the pores of some woods become plugged up with a froth-like growth, known as "tyloses" and the cell walls, and in some species the cell cavities, become infiltrated with various substances, some of which darken the wood.

In over 500,000 tests which have been made by the Forest Products Laboratory, Madison, Wis., on the various species of woods grown in the United States, no effect upon the mechanical properties of the wood due to its change from sapwood into heartwood has ever been noticed. The heartwood of pine, oak and other structural timbers is not intrinsically stronger than the sapwood, as has often been supposed to be the case. Nor is the sapwood of hickory and ash intrinsically stronger than the heartwood, as is sometimes claimed in connection with handle stock.

The essential differences between heartwood and softwood are as follows:

Heartwood, as a rule, is more durable than sapwood in damp locations and less subject to attack by stain and mold-producing fungi. It usually is colored and therefore considered more ornamental than the white sapwood, except in a few cases. In yellow pine interior finish and maple flooring, for example, the white sapwood is preferred. Heartwood is less permeable to liquid and therefore more suitable for tight cooperage, tanks and conduits. It responds more slowly to changes in atmospheric humidity, which often is of advantage when uncoated wood is exposed for a relatively short time to a different humidity.

Sapwood, as a rule, takes preservative treatment better than heartwood. It seasons faster, but when green usually contains a larger percentage of moisture which often makes it heavier. Because sapwood is the outer portion of the tree it contains fewer common defects, such as knots, shakes and pitch streaks. In resinous species the sapwood usually contains less resin than the heartwood. Sapwood is more free from odor and taste, which may be an advantage in some cases, and a disadvantage in other cases.

Lincoln Highway Shows Good Progress

The eleven states traversed by the Lincoln highway built 235 miles of the route, with the aid of the Federal Government, in 1922, this work costing $4,678,041 or an average of $20,000 per mile. Maintenance during 1922 cost $1,388,126.39, so that the total amount expended on the betterment of the route last year was $6,046,168. The total mileage of each class of road completed as of Feb. 1, 1923, is:

Concrete	578.66
Brick	128.76
Bituminous macadam	327.80
Macadam	287.10
Graded gravel	1,189.22
Natural gravel	62.10
Graded earth	404.39
Natural earth	108.60
Paved city streets	218.50
Total	3,305.13

The total expenditure to date has been $47,000,000.

Reinforcing a Wooden Roof Frame Five Centuries Old

Hammer-Beam Roof Frames of Westminster Hall in London Weakened by Beetles—Steel Auxiliary Members Installed

CENTURY-LONG weakening and sagging of the wooden roof structure of Westminster Hall, in London, recently led to elaborate reinforcement of the work, just completed after being in progress for six or seven years. The hall, which adjoins the Parliament buildings, was built in the years 1394-1399, and long was the place where the kings of England were crowned. The original roof framing is still in place, although repeatedly repaired in past generations, as the attack of wood-boring beetles (the so-called death-watch beetle, *Anobium tessellatum*) endangered the structure. An account of the latest repair and reinforcement work is herewith abstracted from a recent issue of *The Engineer*.

Nearly three centuries ago the work of the boring beetle attracted attention and led to repairs being undertaken. The attack continued, however, "with the result that some of the main timbers have been hollowed out until they are mere shells within which a man might lie." At the same time shrinkage of the timber was going on, and there was some settlement and tilting of the walls due to the thrust of the roof. The aggregate result of these actions was that the ridge of the roof settled about 18 in., while the ends of the hammer beams dropped 12 to 15 in.

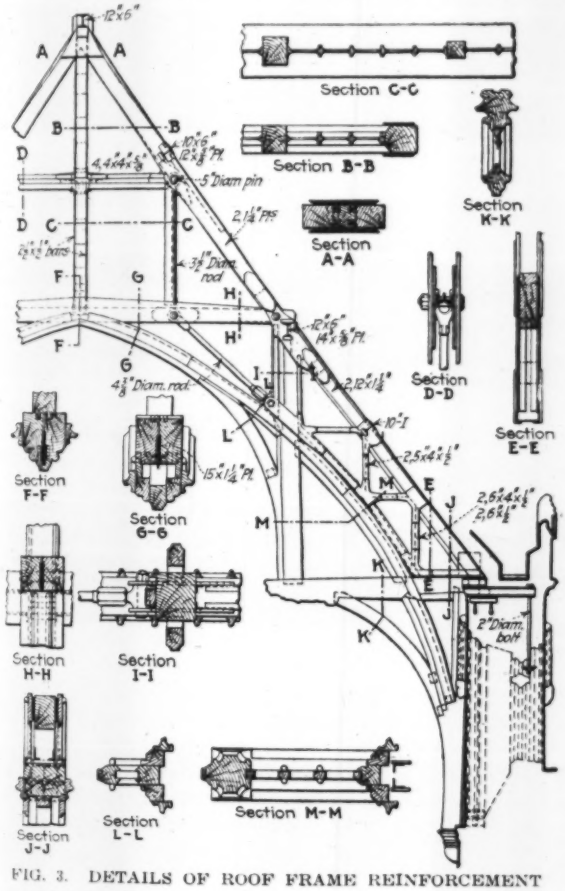
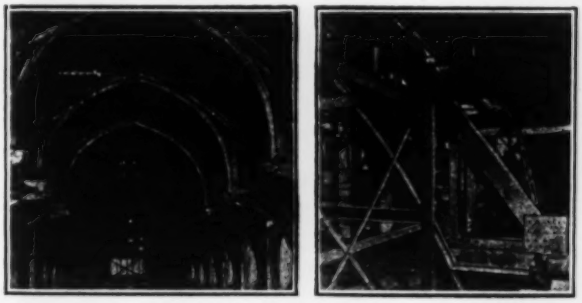


FIG. 3. DETAILS OF ROOF FRAME REINFORCEMENT

The material of the roof frame is oak ("English peduncular oak"), and was framed and erected without very long seasoning. In the present repair work the same variety of wood was used. Comparative strength tests of sound pieces of the original wood and similar modern timber indicate that there has been no loss of strength in the wood during the more than five centuries since cutting, except by decay and insect attack.

Fig. 1 gives a view of the roof as reinforced, but represents the original roof in all particulars, as the reinforcement has not changed its appearance. In the drawing, Fig. 3, the structure of the old roof may be seen, together with the present steel reinforcement. In the original structure the large arch and the auxiliary arches merely served for lateral bracing or stiffening of the roof but because of the settlement of the roof the large arch gradually came to carry most of the roof weight, receiving its load through the tracery members filling the space between the arch, the rafters and collar beam.



FIGS. 1 AND 2. WESTMINSTER HALL ROOF UNCHANGED IN APPEARANCE BY STEEL REINFORCEMENT
Fig. 1—In foreground, truss reinforcement completed; in background, traveling falsework.
Fig. 2—Reinforcement by steel check plates at rafter heel.

Earlier repair work had been done by cutting out decayed parts of the wood and inserting patches to restore the original outlines. Though in one case a large cavity resulting from the work of the borers had been filled with concrete. Additional timbers, bolts, tie-rods, straps, and shoes had been applied at various times, apparently with little regard for the structural principle of the roof.

For the present reinforcement, carried out by Sir Frank Baines, of the Office of Works, the principle of retaining the appearance of the old structure, and in fact retaining the old structure itself, was followed quite thoroughly. Study of the roof showed that it was possible to introduce a steel trussing system consisting partly of cheek pieces on the old timbers and partly of auxiliary tie-rods and truss web members, so as to carry the entire load directly to the walls and yet have the new work concealed by the old framing.

Execution of the reinforcement work was carried out with the aid of traveling falsework fitted to the roof clearance and adapted to carry a pair of trusses while they were under reconstruction.

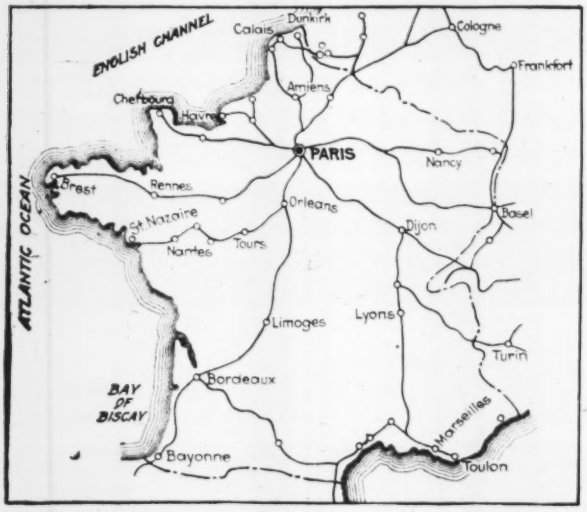
The arrangement of the steel reinforcement is clearly apparent from Fig. 3. It is to be noted that I-beam purlins have been inserted to take the weight of the roof sheathing. To provide for expansion, these purlins are supported on bronze bearing plates. The steel trusses, whose connections are bolted and not riveted, were spread by hydraulic jacks before they were swung, by such an amount as to prevent all further spreading movement under the weight of the roof loads.

Railway Conditions in France, Germany and Poland

French Looking to Electrification—Germany Must Realign System—Poland a Key State—All Have Unbalanced Budgets

This is the second of three articles on the European railway situation by the London correspondent of Engineering News-Record. *The first article, "A Survey of Railway Conditions in Continental Europe," appeared in the issue of Mar. 8.*

THE French railway systems have a lot of leeway to make up before they can give the same service as they did before the war. Prior to 1914 the five great companies of France earned enough to cover their expenses and to have something in hand for development. It is only since the state assumed control that a falling off in efficiency and earning power was registered. And this with rates of 3.4 centimes for passengers, and 4.12 centimes for freight, per kilometer.



MAIN STEMS OF FRENCH RAILWAY SYSTEM

As one might expect, the war completely disorganized the entire system. Though it was only a section of the French system which was directly involved, all the lines were engaged to a more or less extent in the transportation of war personnel and equipment. Under military control the trackage deteriorated, destroyed coaches and cars were not replaced and damage was not made good. On top of this gradual all-round deterioration came total destruction of sections of the northern and eastern systems, the 8-hr. day and increased operating expenses.

Operations of war not only led to the complete destruction of the trackage and rolling stock in the affected areas, but the German army also systematically blew up every bridge in its retreat, as well as railway repair shops, depots and other plants. At the same time the work of reconstruction was hampered enormously by the fact that the areas occupied by Germany were totally devastated, so that working forces engaged in repairing and relaying had to be provided with accommodation just as they would have to be were they engaged in a district previously uninhabited. This naturally added to the expense of rebuilding, which was calculated at the close of the war to be around 3 billions of francs. The position now is that all the destroyed lines and bridges have been rebuilt or replaced, but that the other plant, depots and repair shops are still lacking. This work of track and bridge rebuilding has cost 2,000 million francs and has provided work for 50,000 skilled and unskilled men.

Effect of Eight-Hour Day—This work of reconstructing the northern and eastern systems, as well as other railway operation, has been made more difficult by the introduction of the eight-hour day under the Versailles Treaty. This decrease in working hours has been accompanied by decreased efficiency which means that additional labor to cover both losses has had to be engaged. In fact one French railway authority estimates the increase of working force attributable to these causes to be not less than 40 per cent of the pre-war staff. This additional 40 per cent includes few experienced railwaymen or skilled workers, so that additional supervisory service has had to be engaged, and also, of course, the clerical staff has had to be reinforced in proportion. Before the war the French skilled railway worker was among the most efficient of his type. Many of these men were lost and the general level was lowered so that admission had to be made easier.

The French have always been firm believers in one locomotive, one crew. So as to maintain this principle, which they affrm is essential to economic working, more locomotives have been provided to accommodate the crews.

All the factors, then, have led to enormous increases in expenditure, some of which appears to the foreign observer justified and some not. The railways are now endeavoring to make a cut in this expenditure by so arranging the working hours that a full day's work is done. This is proving difficult in the face of trade union opposition. Even provided that an economical re-arrangement is arrived at, the resultant economy must be negligible in view of the swollen staffs and the decrease in individual efficiency.

The increased prices hit the French railways very hard because they were not able to pass any appreciable portion of the heavier burden on to the consumers as rail rates are under state regulation. Various increases in rates have been made in an effort to balance the railway budget and a 75 per cent increase in fares and 140 per cent rise in freight rates still leaves a margin on the wrong side.

Look to Electrification—There is extremely little technical improvement to record in France during the past five years, aside from experiments on various types of rail traction, such as condensing and internal combustion locomotives. French railway engineers feel their salvation lies in electrifying those parts of the French system near convenient sources of water power. The Ministry of Public Works has begun on a scheme to electrify 6,000 miles in the south of France, which it is estimated will save 3 million tons of coal a year. France's greatest source of water power is in the Pyrenees district. The Midi section is especially favored and has four generating plants available for its service. One, utilizing the Tet, produces 5,200 hp. from a reservoir at 6,500 ft. holding 460 million cu.ft. of water. Another station produces 2,600 hp., and a third 18,000 hp. These stations are to be reinforced by power from Lake Artouste, estimated at 130,000 hp., and from the upper valley of the Tet, estimated at 170,000 hp. The Pyrenees afford plenty of water throughout the

winter and their topography facilitates the cheap construction of reservoirs.

In spite of the fact that reconstruction of the destroyed systems has been carried out so expeditiously, the most optimistic of the French railway executives admit it will be years before the railways regain their pre-war standard. The chief factor in the situation is, of course, the politician and, provided Germany remains solvent and meets part, at any rate, of her obligation, there is every hope that one day French railway expenditure will be more than balanced by receipts, and rail transport in France will again be as efficient as it was prior to 1914.

The German Railways—The same factors, originated by the war, have contributed to the present inefficiency of the German railway system as in France, except perhaps, in a more pronounced degree. The chief of these were the employment of the railways for military purposes and the gradual accumulation of repairs and renewals. Germany's wartime railway services differed from those of the other European belligerents in this respect: whereas the Allied nations were mostly concentrating their efforts on one front, the German railways were obliged to serve a number of fronts.

Consequently German locomotives and rolling stock were to be found transporting troops and material to Belgium, France, the Russian front, through Austria to the Balkans and even down to Bagdad. Her allies were not so well equipped with railway material so that Germany had practically to operate the whole of the railway systems of herself and her allies. This fact naturally lowered the efficiency of the German system itself and her losses in rolling stock outside her own borders were enormous. There is evidence, however, that Germany was prepared for such a position and her military railways were not weakened in consequence to the extent they would have been had the war come as a surprise.

Effect of Allied Blockade—Added to this abnormal railway burden were the effects of the Allied blockade which effectively cut off from Germany her normal supplies of railway material which she received from abroad, namely, bearing metal, copper and rolling stock lubricating oils. By this she was forced to employ more or less satisfactory substitutes such as iron fire boxes, which gave railwaymen great trouble in maintaining locomotive efficiency.

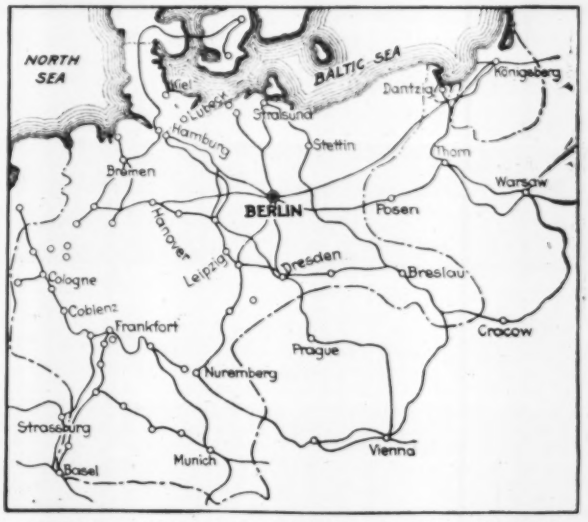
Thus, for four years the German railway system gradually deteriorated, culminating in the demands from the Allies for the surrender of rolling stock. The German railways are very bitter over this and complain that they had to surrender within a very short period 5,000 locomotives and 150,000 cars, all in first-class condition. The Germans maintain that they were forced by the treaty conditions to give up rolling stock for which the Allies had no use, and that cars in really excellent condition and built specially for surrender, were rejected on account of very minor faults.

The Allied commissions, on account of various German subterfuges to evade their obligations, found they had to be extremely careful in what they did accept, and that, in consequence none but the best rolling stock was allowed to cross the frontier. The German railway system was also upset by the surrender of territory which cut off portions of her trackage. In this way depots and junctions have had to be reorganized.

The Personnel Problem—The personnel of the German railways was considerably depleted to fill the army, and the places of skilled men were taken by women and individuals of inferior intelligence and physique. After the war, a number of demobilized soldiers, many incapacitated, were absorbed by the railways. Now the systems are overstaffed but the general efficiency is low, not only due to lack of experience but also to the unsettled conditions produced in the labor ranks by the republican revolution and other minor *coups d'etat*.

In Germany as well as in France the 8-hour day has been responsible for greatly increased expenditure and reduced efficiency. In fact, one German railway executive estimates the staff to be increased by 40 per cent on a reduced system, and the falling off in individual efficiency to be equally high. Although the number of locomotives employed on the German railways has risen by about ten per cent, nearly half of these are under repair at any one time. In fact, of the 33,000 locomotives on the schedule, about 15,000 are undergoing repairs. In addition, the consumption of coal per locomotive has increased nearly 50 per cent.

These factors have contributed to enormously swollen costs of railway operations, which the systems have



PRINCIPAL LINES OF GERMAN RAILWAY SYSTEMS

attempted to recover by increased rates. By far the larger proportion of these rates has fallen on freight traffic, and this is reflected in the fact that the transportation of freight is now only about half the pre-war figure. Passenger fares have taken a share, but a very small share, as German experience has shown that even a small rise in passenger fares brings about a substantial drop in travelers.

In spite of larger tariffs, amounting in all to an increase of about 1,000 per cent, the deficit on the railways is still very high, and a charge of 450 marks per ton of freight carried, against 4 marks in 1913, leaves a deficiency of 7 billions of marks.

Realignment of System—In addition to the reorganization problems ordinarily produced by a war, the German systems have to adapt themselves to a redirection and redistribution of traffic. The mineral traffic especially has been so affected, chiefly, of course, on account of the ceding of the Saar district to France.

In short the German system may be likened to a body from which the limbs have been amputated. Before the war these limbs carried on enormous international traffic

right across Europe to the Balkans. As a result of amputation the arteries and veins must be reconstructed and the system so arranged that the flow of traffic is confined within the outline of the trunk. In consequence not only have interconnecting lines to be rebuilt but other facilities must be afforded for dealing with traffic which formerly passed straight into foreign territory.

This, combined with the arrears of rolling stock repairs and the serious financial situation, is one of the biggest problems yet to be handled by the German railway administration.

The Polish System—The significance of the Polish railway system in Europe lies in the fact that it constitutes a "corridor" between the east and the west. Passengers or freight from Britain, France or Germany to Russia pass over the Polish railway systems. Similarly traffic between southeastern Europe or the Balkans and the Baltic ports is carried through Polish territory. Nearly all these railway lines pass through

IMPORTANT RAILWAYS OF POLAND

or near Warsaw. For instance the main line between Breslau-Oppeln-Warsaw-Grodna before the war carried a great international traffic. The other routes of great international significance, all of them from west to east Europe and Asia, are the Breslau-Oppeln-Cracow-Lemberg, Posen - Thorn - Osterode - Insterburg - Kovno, Neustadt-Radom-Brest-Litovsk routes.

The fact that these routes are of such international significance has led to their early reorganization, and express trains are running daily between east Germany and the port of Konigsberg on the Gulf of Dantzig. In spite of the fact that immense material damage was done during the war to the Polish lines, the service generally is tolerable and much better organized than in many other European states. Poland was hindered considerably in her work of reorganization by the turbulence of her Russian neighbor, and also by the fact that the lines near her eastern boundary were laid by Russian engineers with purely a military and not a commercial objective. Most of these lines were only suitable for bringing troops and material to the Russian frontier during a war and were useless, or very nearly so, to Polish industrial development. Again, when the Germans drove the Russians back during the war, the Russian army, to hinder Germany, destroyed every railway bridge in Poland as well as all depots and repair shops, and seized all locomotives and rolling stock.

Work To Be Done—This work of rebuilding is just about half completed, and about three thousand bridges of varying sizes remain to be reconstructed on a permanent basis. In addition 60 per cent of the depots must be entirely rebuilt and many redesigned to accommodate the altered traffic conditions. As might be expected Poland is still very badly off for rolling stock and possesses only about one-quarter of her actual requirements. Possessing around 15,000 miles of railways she has under 5,000 locomotives, and 10,000 passenger coaches and about 120,000 freight cars.

Much of the present trackage is single only, and to provide for the industrial development which is so confidently expected of Poland, much of the existing way must necessarily be doubled. At present the system is only sufficient to carry her own industrial produce, and is not adequate to cope with the potential passenger traffic. In addition, though parts of the railway system are well laid and will carry heavy traffic, much of it needs reinforcing and often entirely re-laying before heavy trains or normal passenger speeds can be carried.

Poland is particularly short of passenger locomotives, and she has only enough to maintain a fraction of the potential passenger traffic. Many of these locomotives are very old and have not been constructed for prolonged service, with the result that nearly half of them are perpetually undergoing repairs.

One of Poland's greatest difficulties is lack of finance to reconstitute the system and purchase fresh rolling stock. Until very recently Poland has maintained a large army in consequence of her situation between two countries in varying states of exhaustion and this has swallowed large sums of money. Even now her railways occupy either first or second place on the national budget with an enormous deficit. The Polish railways have tried in vain to make good part of this deficit by increased fares and freight rates without raising these to a level where all traffic will be scared off.

On the other hand she has a rapidly increasing traffic and, provided sufficient rolling stock becomes available to carry this traffic, the increased fares and rates may help considerably towards wiping off what is a heavy burden to the Polish state railways.

A Switchback Railway in the Khyber Pass

A 26-mile military railway extending into Afghanistan and having three switchbacks or reversing stations is being built for the Government of India by the Northwestern Railway. This line will form an extension from the present frontier terminal at Jamrud to Landi Khana, in the Khyber Pass. Labor is furnished by the several tribes whose territories are crossed, as it is stated that if the railway should attempt to carry on construction with its own forces the tribes would combine to attack the men and destroy the works, but by negotiations with the several leaders they undertake to supply the labor in their respective districts. Even so, military guards are provided as a precaution against raids by other tribes. W. W. Moylan is engineer in charge of the extension.

Fixation of Atmospheric Nitrogen by Activated Sludge

Nitrogen in the Sewage Has Been Increased by 65 Per Cent—Conditions Favorable to B. Crenothrix with Upwards of 2 P.P.M. of Ferric Oxide Seem Necessary

By C. Lee Peck
Consulting Engineer, New York City

THIS paper is based on data obtained by the writer from plants operated and experiments conducted under his observation and direction at Mt. Vernon, New York City, Urbana, Chicago, Decatur and Indianapolis. Important and essential data have been contributed by engineers associated with him and by others interested in the operations referred to.

Research Work at Mt. Vernon, N. Y.—The discovery that atmospheric nitrogen could be fixed by the activated-sludge process was made at the city of Mt. Vernon in the summer and autumn of 1919, where the Dorr Company erected a 50,000-gal. per day plant. Its purpose was research. There was no expectation of direct financial return. The plant was designed by the writer and operated under his direction.

The unusual results obtained were due in part to local conditions. Mt. Vernon collects its sewage in two trunk sewers. The sewage, with one notable exception, is of domestic origin. The high-level sewer carries little ground water. The low-level sewage is diluted probably 50 per cent. The low-level also receives waters containing rouge from a lens polishing establishment. The sewers discharge into a common grit chamber. The volume discharge from the high level was about twice that from the low level. The combined sewages contained from 1 to 3 p.p.m. of Fe_2O_3. The character of the composite sewage is shown in Table I.

The sewage was prepared for aeration by passing grit chambers and a Dorrco screen with 0.017 in. square openings. There were two aerating tanks in series, with sedimentation between. No sludge was drawn from intermediate sedimentation. The excess overflowed with the partially aerated sewage to the second aeration unit. The settled sludge was automatically returned to the aeration chambers. These chambers were of approximately equal capacity. The first received 75 per cent and the second 25 per cent of the 0.66 cu.ft. per gallon of air used. Sand hutches in both aeration chambers collected the separated inorganic material.

The plant was designed for air economy and to eliminate nitrogen-poor solids from sewage and sludge. The screenings average 1 per cent NH_3; the solids passing the screen, 4 per cent and up. Scum was removed from the primary aerator. It contained little nitrogen. These steps in elimination, together with the means used to promote the growth of biological jelly, produced a sludge with an NH_3 content averaging over 8 per cent.

Sludge research started Nov. 21, 1919. The first step was to determine tentatively upon a method for dewatering and drying. After we had fixed upon this, all sludge samples were treated by this method and weights and determinations made on the *dried samples*. Our reported results are therefore comparable to actual practice All losses occurring in treatment are taken into account. All sludge weights and analyses except as otherwise specified, are for dried sludge.

Acidulation of Sludge—The method of treatment determined upon was: Acidulation of the freshly settled sludge, using ½ c.c. of sulphuric acid per liter of 99.5 per cent moisture sludge; draining through cheese cloth immediately and drying the drained sample at 100 deg. C. The NH_3 was determined by Gunning's modification of the Kjeldahl method.

Our first sludge analysis indicated 9.52 per cent NH_3, dry basis, on dried raw sludge and 10.22 per cent NH_3 on a sample of the same sludge prepared for drying as stated above. This concentration of NH_3 was due to solution of alkaline sludge constituents. It was attended with but slight loss of NH_3. The constituents of the dried sludge are shown in the analysis of Mt. Vernon sludge (Table II).

Fixation of Atmospheric Nitrogen—In addition to recovery of the highest possible grade of ammoniate, it had been a part of the writer's program to determine whether atmospheric nitrogen actually was or could be fixed by the activated-sludge process. Reports of the success of work of Dr. Lipman of Rutgers in fixing atmospheric nitrogen with soil bacteria led the writer to consult him. Acting on his advice, some cultures of azotobacter chroöcoccum were secured. We had attempted to grow these in various dilutions of sewage but had met with no success. Some of the investigators of soil fixation of nitrogen had remarked on the apparent necessity for the presence of ferric oxide. Our sludge analyses had disclosed the unusual quantity of ferric oxide present. We began to study the biology of the sewages and the sludge and to look for abnormal conditions. It had long been noted that the low-level sewage contained a flourishing flora. Quantities of biological

1. Under certain conditions it is possible to fix atmospheric nitrogen by aeration in the presence of activated sludge.

2. The amount of atmospheric nitrogen so fixed has in some cases been equal to 65 per cent of the amount of nitrogen in the sewage.

3. The condition essential to fixation of atmospheric nitrogen seems to be an environment favorable to the growth of B. Crenothrix.

4. Where fixation was successful it was possible to recover 848 lb. per day of dry humus per 10,000 people contributing to the sewage. The humus had an average ammonia content of 7.92 per cent.

5. The presence in the sewage of 2 p.p.m. of ferric oxide seems to be essential.

6. A detention period in aeration in excess of six hours is probably necessary.

7. The quantity of air used is not a controlling factor so long as a healthy aerobic sludge is maintained.

jelly were discharged. Our biologist, S. L. Neave, identified crenothrix polyspora as the predominant organism in this jelly.

We felt justified in adopting the hypothesis that fixation of atmospheric nitrogen was occurring; and that this was made possible by the presence of ferric hydrate. We proceeded to test this hypothesis as follows: *Equipment:* Two eight-liter bottles fitted with glass tubing and compressed air for aeration. *Reagents:* In Bottle I, 6,150 c.c. of screened upper-level (iron free) sewage and 2,050 c.c. of No. 2 tank sludge. After mixing, 200 c.c. removed for analysis. In Bottle II the same reagents as in No. I. In addition, a number of strips of stove-pipe iron were suspended in the bottle. *Procedure:* Bottles were aerated, decanted and filled daily with upper-level sewage for ten days. Samples of decanted liquors, feed, original charge and final contents were preserved with chloroform and analyzed. *Results:* Bottle No. I showed a loss of ammonia of 17 per cent. Bottle No. II showed a gain of 62.5 per cent.

TABLE I—AVERAGE ANALYSES OF COMPOSITE SAMPLES OF MT. VERNON SEWAGE FOR MONTH OF NOVEMBER, 1919

	P.P.M.
Total solids	596
Suspended solids	245
Dissolved solids	351
Alkalinity	265
Oxygen consumed	154
Iron as Fe_2O_3	2.67

Confirmation Tests by Dr. D. D. Jackson—The Dorr Company recognized the importance of these discoveries. Also the necessity for their confirmation by independent research. Dr. D. D. Jackson of Columbia University was retained. His investigation covered a period of three months. Its results are summarized in the following excerpt from his report:

The object of this investigation was to study and verify the results obtained by the Dorr experimental plant at Mt. Vernon, N. Y., and to determine whether these results could be obtained, using New York City sewage. The conclusions are as follows:

1. The Dorr method of sewage treatment requires much less air to activate the sewage and is therefore more economically operated.

2. A sludge of decidedly greater nitrogen content is produced by this method than by any other form of treatment. This is of great importance as its sale as a fertilizer should more than pay the cost of operation. [Ammoniates were then quoted at $8 per unit, making the recoverable sludge worth $56 per million gallons of sewage treated. C. L. P.]

3. The time of contact of the air with the liquid and the complete suspension of the sludge not only serve to fix much of the nitrogen in solution, but *the results show that nitrogen is actually fixed from the air blown in.*

TABLE II—ANALYSIS OF MT. VERNON SLUDGE.* DRIED TO 9.24 PER CENT MOISTURE

	Per Cent
Moisture	29.25
Non volatile	27.34
Insoluble	13.50
Soluble	13.84
Volatile	63.35
Ammonia (NH_3)	8.79
Phosphoric acid, (citric sol.)	1.67
Ferric oxide	9.95
Calcium oxide	5.92
Magnesium oxide	0.13

* Not acid treated.

4. In this process, the nitrogen is largely fixed by crenothrix growths which normally contain from 8 to 9 per cent nitrogen as ammonia.

5. This growth requires the presence of iron in the liquid, so that if the original sewage does not contain a sufficient amount to support the organism, some iron must be added.

Concurrent with Dr. Jackson's investigation nitrogen fixation was being demonstrated at the full capacity of the Mt. Vernon plant. Two tests were made. In the first (see Table III) 316,150 and in the second 413,110 gal. of sewage were treated. Table III gives the result of the first test. The second test may be summarized thus: There was a loss of 6.1 per cent of total ammonia in the primary aerator and a gain of 6.7 per cent in the second aerator. The total gain in solid nitrogen was 53 per cent. The total solids in the accumulated sludge were 759 lb. Losses incurred in treating the sludge brought this down to 692 lb., having an ammonia content of 7.92 per cent. Reduced to a basis of population contributing to the sewage, this amounts to a daily production of 848 lb. fertilizer, 7.92 per cent NH_3, for each 10,000 population.

These tests were conducted from Dec. 27 to Jan. 24, during zero weather. The sludge was lower in nitrogen than for any other period of plant operation. The bottle tests were conducted at summer temperatures. From all the facts it seems justifiable to assume that, under the conditions obtaining at Mt. Vernon, nitrogen fixation will take place the year 'round and that the quantity of sludge stated as recoverable is a minimum.

TABLE III—RESULTS OF MT. VERNON PLANT TEST NO. 2 SHOWING FIXATION OF ATMOSPHERIC NITROGEN AND PRECIPITATION OF DISSOLVED NITROGEN

	Lb. NH_3
Tank No. 1 received	125 17
Tank No. 1 discharged	112 52*
Loss by combustion	12 65
Tank No. 2 received	120 97*
Tank No. 2 discharged	138 82
Fixation of atmospheric nitrogen	17 85
Precipitation of dissolved nitrogen:	
Tank No. 1 received solid nitrogen	22 14
Tank No. 1 discharged solid nitrogen	27 57*
Gain in solid nitrogen	5 43
Tank No. 2 received solid nitrogen	35 77*
Tank No. 2 discharged solid nitrogen	45 45
Gain in solid nitrogen	9 68
Net gain in solid nitrogen	15 11
Per cent gain	68.2

* This apparent discrepancy is due to taking into account the amount of nitrogen in the tanks at the start and finish of the test.

Further Tests—Bottle tests have been made on sewages at Decatur, Argo, Urbana, Indianapolis. At none of these stations have we been able to induce a growth of crenothrix. Fixation of atmospheric nitrogen has occurred at none of them. Precipitation of nitrogen from the liquor has, with the exception of Indianapolis, been marked. At Decatur, treating a sewage containing gas house and starch factory wastes, sewage undosed with iron yielded 0.525 tons of 6.35 per cent NH_3 sludge solids. Dosing with 4 p.p.m. Fe_2O_3 yielded 1.245 tons of the same NH_3 content per million gallons of sewage treated.

Bottle tests were charged with fresh sewage once each day. They have in most instances been aerated in excess of commercial operation. In plant operation, precipitation of dissolved nitrogen frequently occurred in the primary aerator; fixation of atmospheric nitrogen did not. The effluent from the primary unit always showed combustion of nitrogen and generally of solids. Precipitation of dissolved nitrogen does not depend upon the presence of crenothrix. Fixation of atmospheric nitrogen has never occurred except in the presence of flourishing new growths of crenothrix.

Excerpts from the report of the biologist, S. L. Neave, under the heading "Observations and Deductions on Biological Activity," follow:

Reduction of soluble nitrogen follows crenothrix count.

Reduction of soluble nitrogen inversely proportional to loss of total nitrogen.

Loss is proportional to amount of nitrate and nitrite present.

Nitrate follows nitrite.

Decrease in alkalinity, increase in crenothrix and decrease in soluble nitrogen.

Increase in proportion of crenothrix showing ragged outlines concurrent with increase in loss of nitrogen.

To which the following observations may be added: Satisfactory effluents were consistently obtained without producing nitrates or nitrites.

The crenothrix count in the primary aerator was to the crenothrix count in the secondary aerator as 4:6. The amount of air admitted to the secondary aerator approximated 0.05 cu.ft. per gal. of sewage treated per hour.

The methods described removed the nitrogen from the sewage. From a sanitary standpoint this is preferable to changing the nitrogen to so called stable forms. These, inoffensive in themselves, are food for organisms which may produce nuisance. Fixation of nitrogen, liquid or gaseous, in a solid form and its recovery for use as a fertilizer is of great economic importance. The writer is convinced that means for effecting these ends are now available and at less cost than the methods now employed in the activated sludge process.

[*In a subsequent issue there will appear an article by Mr. Peck on "Economics of the Activated-Sludge Process."*—EDITOR.]

Winter Road Grading and Graveling in Minnesota

Heavy Grading, Gravel Surfacing and Stockpiling Suitable Operations for Cold Weather —Examples Presented

By J. H. MULLEN
State Highway Engineer of Minnesota, St. Paul, Minn.

Extract from a paper read before the American Road Builders' Association, Chicago, Jan. 18, 1923.

BECAUSE of the nature of road work the problem of winter operations seems rather difficult, but the experience in Minnesota is that it can be greatly simplified by planning well in advance. This is true particularly of grading; every year there are a number of projects on which there is rock excavation or heavy earth work, with deep cuts and large enough quantities to warrant the use of steam shovel equipment, which can operate on that work as well in the winter as in the summer.

An example is a last winter's job 5.1 miles long, involving 172,600 cu.yd. of excavation—of which 110,167 yd. was rock—which was done at a price of 19c. for earth, 65c. for loose rock, and $1.30 for solid rock. Winter work cannot be credited entirely with these low figures, for the work was very heavy, averaging nearly 34,000 cu.yd. per mile, and the rock was a soft limestone, but attention is called to this job as being especially suitable for winter work.

Another project is 40 miles of grading on new location now being performed on which the estimated quantities are 418,000 cu.yd. of earth and 130,000 cu.yd. of solid rock, which was let at a price of 45c. for earth and from 95c. to $1.60 per yard for rock. This is in a timbered country, rather inaccessible, and the prices are low when it is considered that there is no loose rock classification and the solid rock is a tough granite or trap. The variation in rock prices on this job is due to the fact that some of the rock excavation is along the bluffs on the shore of Lake Superior, which allows for side casting without any haul and is being done at a price of 95c. per yard while the rock work involving haul costs $1.60. Letting this work in the Fall also allowed for all of the clearing on the line, about 316 acres, to be done in the early winter.

On the whole it is believed that such conditions as existed on the two projects mentioned and which prevail in a measure on a good percentage of our work, can be handled in the winter, or as combined winter and summer projects, to the advantage of all concerned.

In the northern states most roads are being improved by gravel surfacing. Taking again, as an example, the state of Minnesota, in the past two years there were 1,675 miles of this kind of work done by the state alone, with an average of 1,500 cu.yd. of gravel per mile, or a total of about 2,512,500 cu.yd., of gravel hauled. In addition to this there was 1,750,000 cu.yd. hauled by the counties on secondary roads. A portion of this had to be done in the summer on account of wet pits and the necessity for shipping in cars, but it has been found that a great deal of this material could be hauled most economically in the winter especially when long hauls were involved. This is due in part to the lower labor rates, but is principally due to the fact that when the roads are frozen smooth, and the highway department makes it their business to see that they go into the winter in that condition, the trucks or wagons, as the case may be, have the benefit of a surface to haul over which is as good as a concrete road, and which permits of a maximum loading and consequently a lower unit hauling cost.

As an example, last winter one contractor with a fleet of 26 trucks hauled 28,000 cu.yd. of gravel an average of nine miles in 25 days. The contract price for this work was 20c. per cubic yard mile, and the average truck load was 7 cu.yd. This would have been impossible in the summer, not only because the contractor could not have hauled so cheaply over earth and gravel roads in the summer, but because the highway department would not have allowed such equipment to be used on account of the damage or destruction of roads being hauled over. Summer gravel hauling is restricted for this very reason to pneumatic tired trucks which of course limits the loads to about three yards. In the past winter, Minnesota contracted 1,350,000 cubic yard miles of gravel hauling by truck at an average cost of 22c. per yard mile. This compares favorably with the average cost of 27c. per yard mile for summer haul.

Winter graveling is not by any means confined to truck hauling. Perhaps the greatest benefit of this work to unemployed has been where the material has been hauled by teams. A striking example of this is the experience last winter in a section of the state where farming and financial conditions had made it very difficult for some of the people to get through the winter. It so happened in that territory that a large mileage of grade was ready for surfacing and dry pits were available. Accordingly all the men and teams that could be used to advantage were put to work as an emergency measure and in all about 500,000 cu.yd. miles of gravel was hauled at an average cost of 20c. per yard mile. This cost is low for team haul but the team owners were anxious to have the work and were willing to work long hours to obtain the money so made available, in fact while the engineers were able to place 340 teams on this work there was probably about one-third as many more who would like to have had the same opportunity. It is needless to say that this operation was of financial advantage to the State as well as a means of taking care of a serious unemployment situation.

Gravel hauled in the winter is generally deposited in continuous "windrows" on the grade, and is bladed to the proper section and compacted under traffic the following spring. While there is sometimes considerable loss of winter gravel due to muddy sub-grade conditions in the spring this is more than overcome by the lower cost of the winter work and by the advantage of having the surfacing deposited and in good condition before the road would otherwise be ready to carry any traffic. Even without these advantages, it is good business to haul this heavy tonnage in the winter in order to avoid the damage to earth and gravel roads over which the material must be hauled, and which are badly cut up by such hauling in warm weather.

Thirty Years of Bridge Engineering on the Pennsylvania Lines

—An appreciation of J. C. Bland, retiring bridge engineer of Pennsylvania Lines West

THE retirement of J. C. Bland from the position of bridge engineer of the Pennsylvania Lines West on Feb. 1, after nearly thirty years of service in that position, recalls the remarkable development of bridge engineering during the past three decades and emphasizes the part played in that development by his work on the Pennsylvania Lines. Within that period the undeveloped and imperfect practice of the eighties and early nineties, when railway bridge construction was a sharply competitive industry with little of that close control now exercised by the railways through their own bridge engineers, grew to a high degree of technical perfection and thoroughness. The preparatory work of such men as Morison and Schneider had already done much toward initiating this change; and the influence of the high standards and marked independence of thought of a few railway bridge engineers, notably that of Mr. Bland, carried this work forward.

Some of the changes in the development referred to may be suggested by a brief mention of a few of the larger works of the Pennsylvania Lines during Mr. Bland's tenure.

In 1894, when M. J. Becker was chief engineer and Thomas H. Johnson was principal assistant engineer of the Panhandle, the Southwest line of the Pennsylvania system, it became necessary to undertake the rebuilding of the Ohio River bridge at Cincinnati. With its 525-ft. main span, one of the largest simple truss spans in existence at the time, the bridge presented a problem that would be considered important even today, and in the early nineties it was a most formidable task. Mr. Bland was engaged for the work. He had begun his professional career on the Pennsylvania R.R. long before, being assistant engineer on construction work from 1871 to 1874, then had spent a number of years as engineer for the bridge-building firm of Cofrode & Saylor, of Philadelphia, and later had been in practice in Colorado for eight or ten years. Incidentally he had written one of the earliest handbooks for structural engineers, a book prepared for the Pottsville Iron & Steel Co., of Pottsville, Pa., in 1887. He carried through the Ohio River bridge undertaking with entire success, in spite of the special complication introduced by the necessity of keeping open a 200-ft. width of channel through the falsework of the main span. The fact that the new bridge was of pin-connected design is specially interesting because Mr. Bland in later years was the principal exponent of riveted bridge construction, which culminated in his design of the 640-ft. riveted channel span of the Louisville bridge twenty years later.

During or just after the Cincinnati rebuilding Mr. Bland was appointed principal assistant engineer of the Pittsburgh, Cincinnati, Chicago & St. Louis Ry. (the Panhandle), in charge of bridge work. Five years later he advanced to engineer of bridges for the Pennsylvania Lines West of Pittsburgh, including the Panhandle and the Fort Wayne roads. This position he has held continuously until his present retirement.

An even more complicated bridge problem which arose soon afterward resulted in a structure which still, after twenty years, ranks among the country's notable bridges. In 1902 the Fort Wayne bridge over the Allegheny River in Pittsburgh had to be rebuilt, in connection with the construction of the new terminal station a few hundred feet away on the site of the old station but at a higher level. The old structure, consisting of six short spans of multiple-intersection type, was replaced by a very much heavier bridge of long spans, on substantially the same alignment but at a higher level, without interruption of traffic. In order to maintain a freight-yard connection at the old track level, moreover, the new bridge was designed as a double-deck structure, and space was provided for three tracks on each deck, making it by far the heaviest structure of its size ever built; probably the bridge has never been exceeded in this respect by any subsequent structure. The replacement was carried out by rolling the old bridge to temporary supports alongside, at the same time skewing it so as to bring it parallel to the new center line—a most difficult operation—and then erecting the new bridge.

Almost simultaneous with the Fort Wayne bridge work a similar undertaking of only slightly smaller magnitude was carried out, namely renewal of the nearby Panhandle crossing over the Monongahela, a double-track structure replacing an old single-track bridge on the same site.

During this time Mr. Bland was carrying on an extended series of tests of full-sized bridge compression members, begun some years earlier. The results, reported by his assistant, C. P. Buchanan, in *Engineering News* of Dec. 26, 1907, commanded universal attention, and together with the discussion of the Quebec bridge failure of the same year supplied the stimulus to the renewed study of column strength during the next decade.

Two interesting bridge problems arose a short time afterward. One was the combined replacement and reinforcement of the Ohio River bridge of the Panhandle at Steubenville, a structure over twenty years old. The other, a most formidable undertaking, was the reconstruction of the Ohio Connecting Ry. bridge over the Ohio River, just below Pittsburgh. This structure included a 525-ft. and a 400-ft. channel span and a long series of shorter deck truss spans, and was further complicated by a curved approach over the yards of the Fort Wayne line on the north bank. It carried a phenomenally heavy traffic, trains following each other in a continuous series throughout the day, and the service required that traffic should not be interrupted or materially reduced. The reconstruction involved bold and novel procedure throughout, such as the erection of the large channel span around the old span by cantilevering out from either pier, using the halves of the back-channel span as anchor arms, and the replacement of the minor spans by successive erection alongside and rolling in. The successful completion of this work without incident and without traffic interruption represented a notable achievement.

With the Steubenville bridge rebuilding, Mr. Bland

began the extension of riveted construction to long spans, which he thereafter steadily extended. The new deck spans of the Steubenville bridge, 213 ft. long, were the first of any size on the Pennsylvania. The very long channel spans of the Ohio Connecting Ry. bridge, with riveted bottom chord, represented further advance in the development of the type. While somewhat later, the bridges over the Muskingum River near Coshocton, Ohio, and over the Miami River at Dayton, built in 1914 and 1915 to replace structures destroyed in the great 1913 flood, may be taken as good examples of his practice in spans beyond the commonly accepted limit for riveted work.

In 1916 the renewal of the Louisville bridge over the Ohio led to still further extension of riveted construction. The old bridge, built by Albert Fink in 1868-1870, was a most remarkable structure, having deck spans of Fink type and two long channel spans of through Whipple type, as described in *Engineering News* of Feb. 8, 1917 (p. 217). The War Department unexpectedly increased its requirements for channel width to such an extent that one of the channels had to be crossed by a span of 640 ft. Riveted construction had been used for the new deck spans, and Mr. Bland applied it also to the channel spans; the 640-ft. span still is by far the longest of the type.

Most recent of the great bridge undertakings in the series was the raising of the Allegheny River bridge at Pittsburgh to a level 13 ft. higher, a most difficult and responsible piece of work. The bridge was the heavy six-track bridge (only four tracks were ever laid) built in 1902, and its great weight, together with the restricted working space available on the piers, formed an essential part of the difficulty of the work. The other factor was that, as usually only 5-min. working intervals between trains were available for the lifting operations, it was necessary to carry on the whole process as a continuous series of small steps (3-in. lifts), with the gradual insertion between pier and bridge seat of superimposed steel grillages, until the bridge was at its new level.

Going back to a somewhat earlier period, peculiar interest attaches to Mr. Bland's connection with the Eads bridge, which he examined and repaired for the Terminal Railroad Association of St. Louis. Having been built long before the modern great increase of railroad traffic weights had fairly begun, this remarkable arch bridge, with its tubular steel rib chords and eyebar web members, required the most painstaking study of its action and condition in detail, and the development of methods for strengthening it as well as making good the deterioration caused at various points by long service. He carried out this detail study with characteristic ability and conscientiousness. At various times the floor was rebuilt, worn pins at the web eyebar connections were bushed, the structure stiffened by revision of the spandrel members, and assurance obtained that the condition of the arch ribs inside and outside as well as the behavior of the structure in all its parts make it amply able for its present-day service.

This brief mention of a few large enterprises brings out only scattered incidents of a long record of activity comprising a great variety of bridge construction and maintenance work smaller in size but often no less important and difficult. All of the work is equally distinguished by individuality and independence of thought and by a quite remarkable thoroughness, plainly directed toward sound engineering results rather than adherence to fixed practices. It is by virtue of these qualities that Mr. Bland's work has exerted a strong influence on the development of the art during the last three decades. Taking up each new problem as one to be dealt with according to its particular conditions, he has always adapted his methods of design to the needs of the case, and at the same time has assured their effective application by personally working out the designs and analyzing their stresses. The ample proportioning and detailing of his bridges are no less characteristic than his steadily maintained dissent from the general preference for wheel-load analysis and from conventional views of proportioning for impact. The performance of his bridges in service has well justified his methods.

Must the Engineering College Teach Its Students How to Spell?

BY AN ENGINEERING INSTRUCTOR IN A STATE COLLEGE

WHILE engineering students, especially freshmen, are by instinct poor spellers, this past semester seems to have produced an extra crop of them. The following article is a compilation by one instructor, of misspelled words taken from written work handed in at the end of last semester by students in engineering.

Graduates, all of them, of accredited high schools. We begin to wonder at the definition, at least the standard, of an accredited high school. We have heard our parents talk of the three "R's" as necessary requisites for an education. The present day requirements for graduation seem to be changed to the three "M's": Manual Training, Movies, More Uselessness.

OUR SURVAYING PROBLEME

It was an averge fogey Sep. day. The party assembled at the enterence of the Add. Bldg. with the necessary equiptment. A travers was run to the Maden Lain arch. Taking off from the Goverment bench mark, a bronse plait refurred to meen sea level, differencial levels were run over the coarse checking on the last hydrogent. Angles were measured by trianglation with a numbre of repertisions. Barings were observed on each sid with with the cumpus on the transut insterement to the nearest fifteen minuets, dubble centring so as to eliminate all possible eror. Distances were obtained by paseing. The equsion for the length of pase had been found in a previus probleme. It became windey and rainey which increased the work of centreing the plum-bob. The hight of each point was carculated from the differencial levels. The latituds and departurs of the survay were compulated and the aria thus obtained. Deminsions from the travers to the buildings were not taken, as a topograffic survay was not requested.

The indevidal knowlede of each student and opinoins aquired by waching the values of the varius survays fluxicate, should be put in righting by him. Future refrence to them will be necessary. In his work after graduation he many times becomes liabil for engery to munucipal property. By his inergy and care shall he win.

This is our problem—but how can it be solved? Slide rule, mechanics and the calculus, the engineer's tools—all are useless.

Price Paid for Standing Timber in the West

The Standard Lumber Co. of Sonora, Calif., recently purchased from the government 13,300,000 ft. of standing timber within the Stanislaus National Forest in California. The price paid per thousand feet was $4 for sugar pine, $3 for yellow pine, and $1.25 for white fir and incense cedar.

Arc Welding for Steel Structures

Based on a paper read before the Schenectady chapters of the American Welding Society and the American Society of Mechanical Engineers.

BY FRANK P. MCKIBBEN
Professor of Civil Engineering, Union College, Schenectady

WITHIN the past six or seven years some steel structures have been built with neither pins nor rivets, the members being joined together by electric welding. This development in the art of steel construction is now making rapid progress.

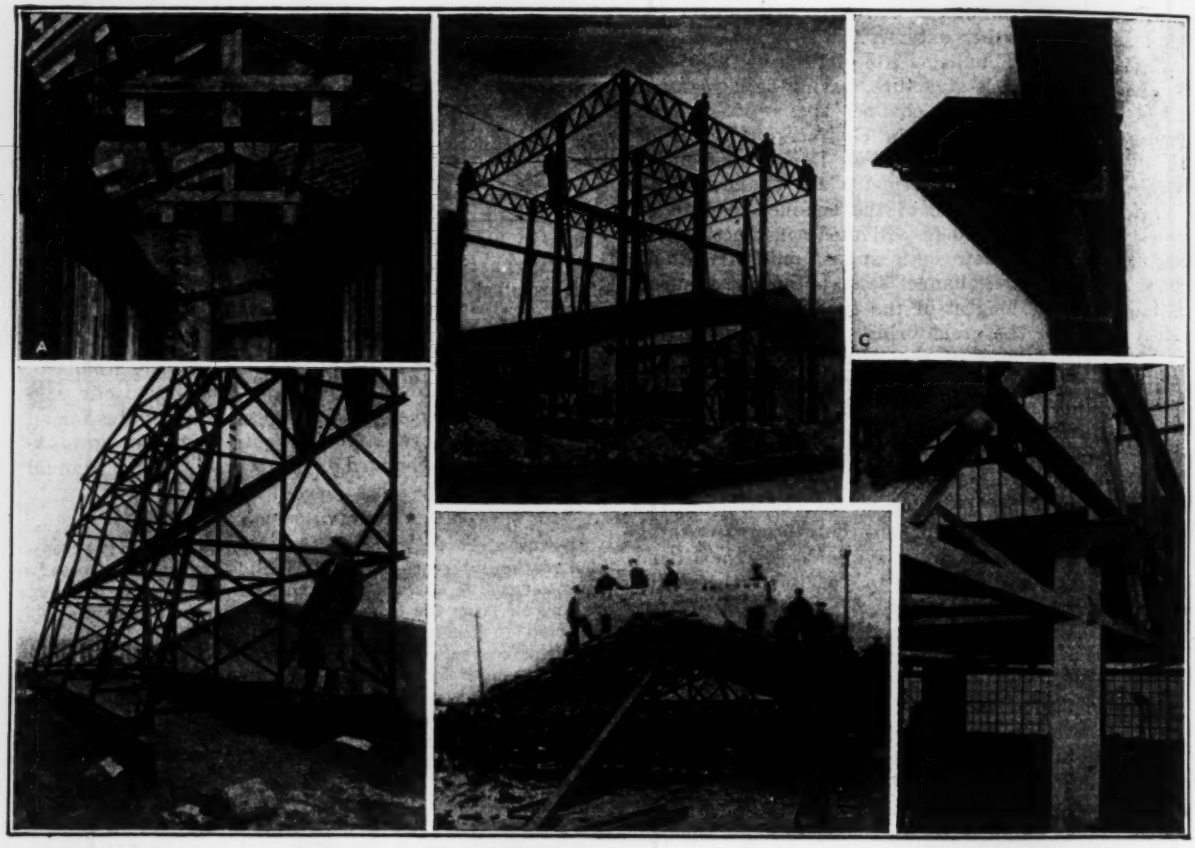


FIG. 1—STEEL STRUCTURES THAT HAVE BEEN BUILT WITH ARC-WELDING OF CONNECTIONS

A—Footbridge, with posts and trusses welded. B—Transformer housing at Schenectady. C—Welded crane runway bracket of transformer housing. D—Steel framework for a large electric sign. E—Full size welded roof truss under load test. F—Crane brackets welded to columns and trusses.

It is quite important that structural engineers therefore should give careful attention to the application of electric welding to steel structures with the view of guiding the art along safe lines. Up to the present time most electrically welded structures have not been carefully proportioned with proper regard for the stresses to be carried and the strength of parts necessary to carry them.

Test Data On Arc Welding—It is unfortunate that practically all of the tests have been made on specimens cut from butt welds and tested in pure tension. At the present stage of the application of arc welding to steel structures we are more in need of experimental data on the shearing strength of electrically welded joints than data on their tensile strength. Practically all riveted joints depend for their strength upon the shearing value of the rivets or on the bearing of rivets upon plates connected.

The best data thus far published on shearing strength of deposited metal of metallic arc welds are those of E. S. Humphrys, Jr., from tests made at the General Electric Co.'s Schenectady plant and at Union College. In these tests each specimen consisted of two $4\frac{1}{2} \times \frac{3}{8}$-in. plates joined together by two $3\frac{1}{2} \times \frac{3}{8}$-in. splice plates in such a manner that the deposited metal (bead) ran parallel to the length of the plates and therefore parallel to the tensile pull exerted upon these plates, with the result that the beads were subjected to shear. The shearing strength of the bead (see Table I) varied from 31,145 lb. per sq.in. for the $\frac{1}{2}$-in. bead to 42,000 lb. per sq.in. for the $\frac{1}{4}$-in. bead, averaging 36,310 lb. per sq.in. and the table shows quite conclusively that the smaller the bead the greater is the unit shearing strength.

It should be pointed out here that when these specimens failed in the testing machine the plane of fracture, i.e., plane of shear, was not the base of the triangular fillet but was on a plane of minimum shearing area extending from the apex of the triangle perpendicularly to the hypotenuse opposite. The plates were of ordinary structural quality and the electrode was a standard commercial bare wire, high in manganese and low in carbon, sulphur, phosphorus and silicon. In specimen 3 the length of the bead was so large that failure occurred by tension in the main plates and not

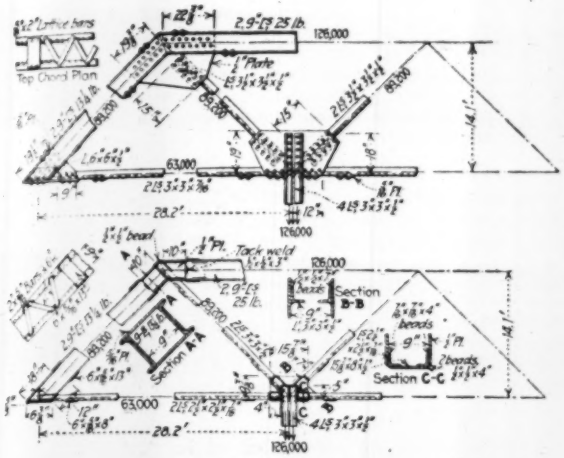


FIG. 2—RIVETED TRUSS AND WELDED TRUSS FOR SAME SERVICE

by the failure of the weld. Each of the results given is the average of four tests; for example, the 142,500-lb. breaking load for test 8 is the average of 146,170, 139,580, 149,990, and 134,250, whose maximum variation from the mean is about 5.3 per cent, while for test 6 the maximum variation in the four specimens was about 1 per cent. These results show remarkable uniformity in the workmanship.

If a factor of safety of four be applied to the ulti-

TABLE I—TESTS ON WELDED PLATES

Test No.	Ultimate Load, Lb.	Net Area of Plates, Sq.In.	Tension, Lb./Sq.In.	Dimensions of Bead, In.	Min. Width of Bead, In.	Min. Shear Area of Bead, In.	Max. Shear In Bead, Lb./Sq.In.	Shear Per Lin. In. of Bead	Method of Failure
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
3	158,420	2.625	60,350	½x6	3/10	7.2	22,000	6,600	Tension in plate
4	149,500	2.625	57,000	½x4	3/10	4.8	31,145	9,340	Shear in bead
5	116,320	2.625	44,310	½x3	3/10	3.6	32,310	9,693	Shear in bead
5-A	45,570	2.625	17,360	½x1	3/10	1.2	37,980	11,390	Shear in bead
8	142,500	3.00	47,500	½x3	0.355	4.26	33,400	11,875	Shear in bead
6	131,110	2.625	50,000	½x3	3/10	3.6	36,500	10,926	Shear in bead
9	120,000	2.625	45,700	½x3	0.266	3.19	37,650	10,000	Shear in bead
10	96,400	1.750	55,100	½x3	0.209	2.44	39,500	8,033	Shear in bead
11	89,650	1.750	51,100	½x3	0.177	2.13	42,000	7,470	Shear in bead
					Average....		36,310	9,840	

mate, the allowable shear on the minimum section is approximately 9,000 lb. per sq.in. Using this value a triangular bead ½ in. deep by ½ in. horizontally, with minimum shearing thickness 0.355 in., has a safe working shearing strength of 0.355 x 9,000 or 3,195 lb. per linear inch of bead.

A Truss Design—In Fig. 2 is shown a preliminary design for an arc-welded truss supported at its ends, having a span of 56.4 ft. and carrying a load of 126,000 lb. at the center. The unit stresses used in the design are: tension, 16,000 lb. per sq.in.; compression, 15,000 — 50 l/r; shear in beads, 9,000 lb. per sq.in.

All welds are of the fillet type, triangular in cross-section. The ⅞ x ⅞-in. fillet has a safe working

TABLE II—ALLOWABLE SHEAR ON ARC-WELD BEADS AT 9,000 LBS. PER SQ. IN.

Depth, In.	Width, In.	Diagonal Thickness, In.	Allowable Stress, Lb. Per Lin. In. of Bead
½	½	0.355	3,195
½	⅜	0.300	2,700
½	⅓	0.266	2,394
⅜	⅜	0.203	1,827
⅜	⅓	0.177	1,593

strength per lineal inch of 0.31 x 9,000 = 2,790 lb., and the ½-in x ½-in. fillet a working strength of 0.355 × 9,000 = 3,195 lb. To determine the required length of fillet to develop the stress in the diagonal it is merely necessary to divide the stress, 89,200 lb., by the safe shearing strength of a ½ x ½-in. bead, or 3,195 lb., giving 27.8 in., or 14 in. for each of the two angles.

The compactness of the joints in the electrically welded truss is very noticeable and there is a great saving of material in such joints over the ordinary type of riveted joint. Just what the saving in cost may be is at present a matter of conjecture, because we have not had sufficient experience to secure accurate cost data on electric welding of such structures. The welded truss also saves material in tension members due to the reduction of cross-section in riveted trusses caused by the rivet holes. Thus, the bottom chord is made up of two 2½ x 2½ x ⅞-in. angles with a gross section of 4 sq.in., and this is also the net section, as there is no

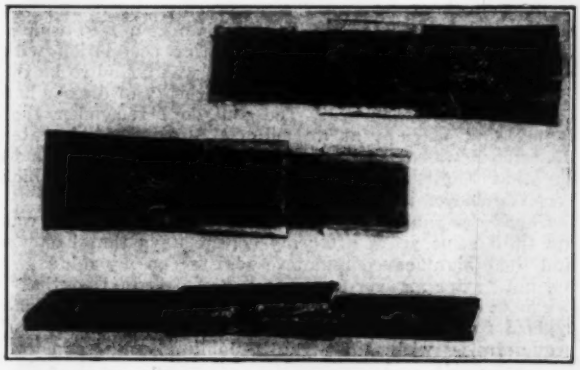


FIG. 3—TEST SPECIMENS FOR SHEARING STRENGTH OF ARC-WELDED JOINTS

reduction of area. In a riveted truss this lower chord would be made up of two 3 x 3 x ⅞-in. angles with a gross area of 4.86 sq.in. and a net area of 3.99. The saving of weight in the tension members of the welded truss over the corresponding members of the riveted truss due to reduction of area caused by rivets alone is 304 lb.

No rivets have been used in the welded truss shown, but perhaps a more careful study would show that greater economy could be secured by using rivets in some places and welding in others. For example, it may be desirable to use rivets in the lattice bars of the compression members which are shown welded.

Activated-Sludge Plant in Reading, England

After considerable delay, apparently due to local financial reasons, the Borough of Reading, England, has let a contract for the proposed activated-sludge sewage-works, plans for which were approved by the Ministry of Health in 1920. The contractor is Activated Sludge, Ltd., Westminster, England. According to *Municipal Engineering and the Sanitary Record*, the plant is designed to serve a population of 90,000 and an estimated dry-weather flow of 2.75 Imp. m.g.d. or 3.3 U. S. m.g.d. Activation will be effected by "the diffused air method." Reading is the largest municipality in England that has yet let a contract for treating the whole of its sewage by the activated-sludge process. G. Midgeley Taylor, consulting engineer, Westminster, England, is engineer for the project.

Engineering and Public Health

Retrospect and Prospect Based on 35 Years Editorial and 21 Years Local and State Health Board Experience and Observation

By M. N. Baker

Associate Editor, *Engineering News-Record*; Formerly President, Board of Health, Montclair, N. J.

Somewhat condensed from one of the DeLemar lectures in hygiene before the Johns Hopkins University School of Hygiene and Public Health, delivered Nov. 20, 1922, and repeated with a slight revision before the Sanitary Section, Boston Society of Civil Engineers, March 7, 1923.

ON THE second Monday in November, thirty-five years ago, I began editorial work on *Engineering News*. Although American engineering then had many notable achievements to its credit they were mostly in the fields of canal, railway, structural, water-power and mechanical rather than sanitary engineering. A notable exception was water-works and a lesser amount of sewerage design and construction; American public health work in 1887 was in its infancy. It then had little scientific correlation with engineering, biology and chemistry, as was bound to be the case before bacteriology and the germ theory of disease had become fairly established. Too well do I remember that in my first attempt at an editorial discussion of water filtration I was misled by the Encyclopedia Britannica to say that English sand filters were mere strainers which remove none of the dangerous impurities from water.

Knowledge and Inspiration from Dr. Sedgwick—It was not until some years after my college days that bacteria and their significance began to register on my mind and not until after an ever-memorable day early in 1892 that I began to grasp the relation between water supplies and typhoid fever. On that day began my long and fruitful acquaintance with that great public health explorer, teacher, guide and source of inspiration, the late Dr. William T. Sedgwick. I called on him at one of the old and crowded buildings of the Massachusetts Institute of Technology to get for publication in *Engineering News* a copy of that classic paper, "Typhoid Fever in Chicago," that he and Allen Hazen had courageously presented before the American Statistical Association on the eve of preparation for the World's Columbian Exposition. The paper was a wonderful marshalling of statistical and other evidence designed to warn Chicago, the Exposition authorities and the country at large that the water supply of Chicago should be safeguarded from typhoid infection before visitors thronged to the Exposition. Dr. Sedgwick gave me double welcome because he found me a willing listener to his gospel of pure water and because he saw through me an opportunity to get publicity for his paper. Full publicity had thus far been denied his paper because, shame to say, there were in 1892 people fearful that knowledge of the character of Chicago's water supply would keep visitors from the Exposition. The paper was secured, printed in full in *Engineering News*, with its illuminating tables and diagrams, and afterwards reprinted and circulated in pamphlet form. Some will remember that finally Waukesha spring water was piped many miles from Wisconsin to the Exposition grounds and that in addition the Exposition authorities built and operated filters to treat water from Lake Michigan. How much the Sedgwick-Hazen paper and its publication by *Engineering News* contributed to those two sanitary measures I will not attempt to say. Unquestionably thousands were thus warned to be on their guard against typhoid-infected water in Chicago and elsewhere.

The Montclair Typhoid Outbreak—About two years after this incident I had impressed upon me by a lesson nearer home the fact that unguarded milk supplies may cause typhoid outbreaks. The incident deserves mention here because its effect in the town where it occurred had much to do with the immediately ensuing establishment on a sound progressive basis of the Board of Health of Montclair, N. J., the work of which, I trust I may be pardoned for saying, has had no small part in the upbuilding of health board work in the United States and of setting a standard for health officers. I was then a member of the Montclair Township Committee, which, together with the Township Physician for the Poor, also served as a local Board of Health. Our health appropriation was $300 a year, for a population of some ten thousand.

Suddenly there occurred in Montclair and vicinity a milk-borne typhoid outbreak with many deaths. By the time it had passed into history a town form of government had been established in Montclair. A Board of Health absolutely independent of the Town Council in all respects except the appointment of the board members and the provision of funds was created and I became one of its first members. With eighty cases of typhoid and a dozen typhoid deaths as a background and full support from the Town Council and the public, the Montclair Board of Health began its work.

Engineer Health Officers—One of its first acts was to engage a full-time health officer. It was realized that no competent physician could be expected to give up his practice for the salary that could be paid by a town of ten thousand. A part-time medical health officer would be either an incompetent practitioner or a rising member of the profession whose private interests and public duties might clash. As an advocate of a full-time, non-medical health officer I was asked how I would go about finding one. I replied that I would appeal to Dr. Sedgwick and I was authorized to do so. Immediately he recommended Theodore Horton, then about to graduate in engineering from the Massachusetts Institute of Technology, where he had taken work under Dr. Sedgwick. Thus we secured the first of a long succession of non-medical health officers for Montclair. Besides Mr. Horton, the Montclair roll of health officers includes M. O. Leighton and Chester H. Wells, engineering graduates; Horatio N. Parker, a one-time M. I. T. student who afterwards served as biologist on the Boston water supply under Desmond FitzGerald, the latter a Past-President of the American Society of Civil Engineers and a pioneer in the sanitary study and protection of water supplies; and, most recent of all, H. B. Larner, who took sanitary biology at the M.I.T. under Dr. Sedgwick and others and was for a time on the staff of the United States Public Health Service. It is worth noting that after leaving Montclair Mr. Horton became chief engineer of the New York State Department of Health; Mr. Leighton took charge of the water supply and water pollution investigations of the United States Geological Survey; Mr. Parker assisted Mr. Leighton for a time in the work just named and afterwards specialized in public milk supplies, wrote an important book on the subject and is now city bacteriologist of Jacksonville, Fla.; Mr. Wells left Montclair after a dozen years of notable work to become special health commissioner of Delaware.

I do not mean to claim any exclusive virtue for the engineer or the sanitary biologist as health officer, but after twenty years of experience with one or the other in the Montclair work and some eight years of subsequent and more impersonal observation of that work, I feel that the engineer and his close allies in sanitation have demonstrated their capacity as health officers.

If anyone were disposed to urge that Montclair, and Elizabeth, and a number of other places in New Jersey and elsewhere that have employed engineer-health officers are small towns, I would reply that for a dozen years the chief of the bureau of health of Philadelphia was John Vogelson, an engineer, while at Detroit another engineer, Harry Vaughan, heads the executive staff of the Health Department.

Allotment for Health Board Work—Reverting for a moment to the Montclair Board of Health and its staff. The milk-borne typhoid epidemic already noted, the able work of the engineer and near-engineer health officers, carefully detailed budgets and straightforward publicity work, all combined to give civic and financial support to the work of

the Montclair board. This I attribute largely to the fact that engineering methods and the engineering spirit have dominated in Montclair and that constantly the aim has been to concentrate on work having a direct bearing upon public health . . . so that the 50 cents per capita spent under the name of public health in Montclair for many years accomplished double or treble the amount of real health work that the same per capita appropriation yielded in many other communities. Not only that. With appropriations low and staff small it has been easier to keep the work of the board free from politics than if there were more money to be spent and more positions to be filled. The Montclair health appropriation is now about 75 cents per capita.

A Definition of Engineering—This seems to be a good point to introduce a definition of engineering which may perhaps aid in making plain my conception of a principle which should guide public health work: *Engineering is the art and science of planning and doing a given task as well as it needs to be done at the least cost consistent with that end.* Such a definition involves a clear idea of the aims of every endeavor, the best but least costly means of attaining those ends, and the faculty of discerning the point of diminishing returns. The latter is of great importance in view of the vast amount of engineering work still undone and that must await doing because of lack of money. Let me make this point clearer. In every city there are numerous public improvements and public services constantly making their demand upon the municipal treasury. If each demand were satisfied idealistically the total cost would bankrupt the city and the taxpayer alike. Each improvement or service must therefore be considered in the light of its relative importance and take its place accordingly in a far-looking municipal program—something all too rare in American municipal life.

Returning now to the point of diminishing returns in the field of public health work. Public funds being limited, so must be the pursuit of the ideal in each branch of public health work in order to achieve the largest possible total gain in saving of lives and sickness. The highest ideals in water supply, for instance, should be postponed when additional expense for further improvement will have no probable measurable effect on typhoid or the general death rate and while there is every reason to believe that the money needed to make the water supply ideal would, if expended on the milk supply, effect a notable reduction in tuberculosis and infant mortality. A more striking illustration would be the concentration of health department effort on garbage disposal, as is so often the case, while no really efficient work is being done to control communicable diseases or reduce infant mortality.

Suggested Plan for State Health Survey—I can illustrate still further the engineering way of tackling public health administration by recounting a proposal I made while I was a member of the New Jersey State Board of Health. I submitted a plan designed primarily to utilize data collected, tabulated, summarized, printed and distributed at great expense to the municipalities and the state and then, for the most part, let go unused. I urged that a competent person be engaged to study the vital statistics of the state, most of which were already sufficiently summarized by communities and by classes of sickness and death. The object of such a study would be to show the relative prevalence in each local health district of the state of every disease or other cause of death which, in the light of existing knowledge and belief, could be appreciably reduced by well directed efforts in public health and sanitation. The exhibit would rank the cities and towns of the state according to their death rates: First general, then by those causes believed to be subject to public control—such as typhoid fever, tuberculosis and infant mortality, to name here only three.

Correlated with this exhibit of community vital statistics from greatest to least would be a study of the most potent factors making on one hand for high and on the other for low death rates, general and segregated. Chief among these, at least for first attention, would be the character and control of water and milk supplies; main factors affecting local public health administration, particularly whether a full-time, competent health officer were employed; adequacy of control of communicable diseases; the amount and efficiency of infant mortality work; and analyses of health board budgets, showing not merely the per capita expenditure of the local boards, but also its allocation between (a) real health-protective work and (b) municipal cleansing (as garbage disposal) and nuisance prevention.

Application of the Plan—Once the data were in hand the high general and special death rates in each community would be studied in the light of the corresponding local facts as to character of water and milk supplies, health department administration and expenditure. There would be clearly evident, in many cases, why a community was at or near the highest general or special death rate in the state. As a corrective to possible false conclusions in some directions, the cities with the lowest death rates—total, typhoid, infant mortality, etc.—when studied in connection with their sanitary works and public-health administration and expenditures, might throw much light on the relative values of various lines of sanitary and health board work and prevent the drawing of false conclusions and the unwise expenditure of public funds.

It would be of little use for any state board of health to do what I have suggested and stop with the printing and circulation of the results. Driving home to each local health board and community the lessons to be learned from these correlated studies is the real thing to be done. In New Jersey, at least, there is ample statutory authority for just this driving home. The legislature has authorized the State Board of Health to frame and adopt a Sanitary Code of state-wide application; and it has made it the duty of the director of health to enforce the rules of the board and the sanitary and health laws of the state. The legislature has been even more specific. It has declared that local health authorities must see that the State Sanitary Code and the state health and sanitary laws are obeyed. Therefore the state health authorities of New Jersey could go to communities with high general or specific death rates, point out the facts and the probable causes and demand remedial measures. In case of failure to adopt the measures indicated, the State Board of Health of New Jersey has authority to cause the necessary work to be done and to collect the cost from the community concerned.

I hope I shall live to see the time when our state health departments will not approve plans for water supply or sewage disposal until their engineers and other specialists have taken full cognizance of the entire sanitary and health needs of the municipality in question with a view of determining whether the expenditure necessitated by the plans would produce more and better results in terms of lives saved if the money were used for some other purpose. In other words, if state authorities are to be dictators over one or two classes of outlays for health and sanitation, let them cover the entire field. Then our state health authorities would be able to guard against expenditures in the name of public health that come within the law of diminishing returns until other causes of diseases and death in the community have been cut down correspondingly.

Progress in Public Health Engineering—Let us now return to the conditions of thirty-five years ago and review broadly but briefly what has happened since then in that part of the engineering field that is most closely related to public health. Since 1887, the number of American cities and towns having public water supples has increased from a thousand to eight or ten thousand and sewerage systems worthy the name from a few hundred to a few thousand. Practically all the water and sewage treatment and garbage disposal plants now in existence in this country have been built since I began to follow these matters for *Engineering News* and nearly all the earlier ones and the more typical of the later ones I have described or been instrumental in having described in *Engineerng News* or *Engineering News-Record.*

No one knows at the present time how many communities in the United States have water-supply and sewerage systems, water and sewage treatment plants, garbage and

refuse collection and disposal and street cleaning systems. Even less knowledge have we of the percentage of the population of the country thus served, or of the percentage of officially laid out and accepted streets that have been paved or of other volumetric elements of municipal engineering and sanitation. Less still is our knowledge of the efficiency of such of these works and services as exist, or of the number, character and efficiency of our local health agencies charged with the protection and improvement of the public health.

We do know, but in general terms only, that vast sums have been expended and are being spent yearly for engineering works having more or less effect on public health—some a very direct beneficial effect, others a less direct and some a probable but quite uncertain effect. Most of the engineering works in question were built primarily as necessities and conveniences and luxuries of modern living conditions rather than to protect health, but in countless and unmeasurable ways both the works that have been named and many other engineering works as well have contributed some part to the upbuilding of the general health and welfare of the country, and to the great reduction in the general and in many specific death rates that has taken place since 1887.

I shall not attempt to give exact figures, but you all know that within the era of public sanitation and public-health-protective work of the last three and half decades the general death rate in some cities has been cut in half and typhoid reduced to a fourth or a tenth or a twentieth and in some cases to a fiftieth or even less of its former annual rate. Other diseases have also been heavily reduced and are still falling, which is also true of the infant mortality rate.

Relative Values—Among all the engineering works that have contributed to the reduction of sickness and death and the accompanying suffering and heartbreaks probably none equals public water supplies—at least not on the North American continent. Probably sewerage systems come next, but if so then it is the quick removal of human excreta from our houses and yards and streets rather than its final disposal that deserves the credit. Plumbing, except as means for distributing water to points of use and removing it after it has been soiled, seems to have but a minor relation to health. Garbage collection is more a branch of municipal cleansing or housekeeping than of health, except where garbage uncollected attracts flies that have access to privies or rats that may spread plague. The final disposal of garbage is still less a health matter. The character of paving and of street cleansing, it seems to me, has far more of a bearing upon public health than has garbage collection or disposal. Where mosquitoes and malaria or yellow fever prevail, engineering works in the nature of land drainage are generally the best and cheapest means of control.

House and building design and construction, with particular reference to air, warmth and light, dryness, the saving of labor for housewives, and general convenience play their part in public health. Heretofore, these things have been regarded as the function of the architect, but for years now we have had heating and ventilating engineers, while in various ways the engineer is becoming more and more concerned with the construction of houses and other buildings. From the engineer we may expect a reduction in the cost of housing that can come only from saving labor and material through systemization, quantity production and other engineering methods. With a reduction in the cost of shelter may be expected a relief from the overcrowding and other evils that undermine health and spread disease.

I believe it is to city planning and its results that we must look for much of the future improvement in public health and particularly for a further reduction in the general death rate in so far as these depend upon engineering work; a reduction traceable not so much to any one readily specified measure as to improvement in many inter-related causes that go to make up community convenience, comfort and mental and physical health.

More Knowledge and Better Health Index Needed—With a general city death rate at or near 10 per 100,000, with a typhoid death rate down to 5, 3 and even 2 or less per 100,000; with infant mortality in progressive communities well below 100 and running on down to 50 or less under well-controlled conditions; and with other elements tending to change what has been called the health yardstick to a foot rule scale, the public health official, and particularly the engineer, needs more knowledge than now exists of what has caused these marvelous declines in mortality and morbidity rates in the past and, of greater importance, what further declines he may expect and by what means he may accomplish them.

I say this knowledge is needed by the engineer in particular because, as I have already stated, it is his habit and peculiarly his function to measure the worthwhileness of proposed works and services in terms of costs and of results. Is the game worth the candle? Can the desired end be better and less expensively achieved by some other means? Would the same amount of money spent for some other purpose save more lives or bring more health?

For many years past the engineer measured the results of his efforts in the sanitary field by the typhoid death rate. At least this was true as regards water supply, the improvement of which in the past is believed to have been the most potent engineering factor in reducing the typhoid and the general death rate.

At the present moment the water-supply engineer is often in a quandary as to how much additional expenditure he is warranted in recommending for one supply instead of another on the possible chance that a few thousand or hundred thousand or millions of dollars—according to the size of the city—thus spent will provide water that will lessen by a shade a typhoid rate almost at the vanishing point or perchance in some way which no one can clearly and positively define reduce some other human ill. The engineer, the health officer, the city councilman and the taxpayer, each and all, need a more delicate and certain index than is available, now typhoid has been reduced to so low a figure, of the causes of the past decline in typhoid and the probable cause of future decline. Have the engineer and the health officer come to the bottom of the curve so far as efforts against typhoid in many of our cities are concerned? Can the experts hereafter merely hold what they have already gained? If further reduction may be expected, and typhoid wholly eliminated, then by what means? Would the same, or perchance much less expenditure, capital and operating, reduce by two or by five per hundred thousand the death rate from some of the causes other than typhoid as against a half or a tenth on the typhoid scale?

Before these questions can be answered we need an intensive-extensive study of the causes of typhoid fever; a study taking into account, chronologically, the volume and the efficiency of the several lines of work that have combined to reduce typhoid fever—such as water-supply protection, filtration and chlorination; milk ordinances, inspection and pasteurization; contact control in its many phases; better medical and nursing care; anti-typhoid inoculation. The same kind of study is needed of other causes of death and related or possibly related public-health work.

Optimum Floculation Point for Alum

Alum will not coagulate properly when a solution is either too "acid" or too "alkaline." Investigators in the hygienic laboratory of the U. S. Public Health Service, E. J. Thereault, assistant chemist, and W. Mansfield Clark, chief of the division of chemistry, report on the relation of hydrogen-ion concentrations (see Public Health Reports for Feb. 2) to the formation of floc in alum solutions the following conclusions: When other possible factors are left out of consideration, optimum conditions for floc formation will be found with a narrow zone of pH centered for dilute solutions at pH 5.5. The more dilute the water in total salt content and the less the alum added, the narrower becomes the pH zone with which optimum floc formation is to be found.

Incomplete Development Prevents Success In Irrigation

Engineering Work Is Not Finished When Canals and Laterals Are Built — Preparation of Land for Farmer Equally Important

By Dr. Elwood Mead
Department of Rural Institutions, University of California, Berkeley, Calif.

TOO GREAT a burden for the farmer, due to incomplete development of irrigated land, has been the greatest single factor in the tragic percentage of failures among settlers on newly opened irrigation projects. The construction of an adequate, well-supplied canal system, even when the water is delivered to each individual tract, is only part, perhaps less than half, of the work that must be done before actual farming operations can begin. It is too much to expect the average settler unaided to bridge the gap between raw land and a farm that will support him; financial or engineering aid, sometimes both, are needed.

Before considering the question of how to render such aid, however, the need for it must be recognized. The issue has too often been evaded where it should have been faced squarely. There has been a fear that any such aid would be "paternalism" or "coddling the settler." Paternalism in colonization is an extreme to be avoided but it is not a menace to our rural development. On the other hand, the opposite extreme of leaving the settler to shift for himself on raw, unimproved land is not only a menace, but has been and is actually retarding in a very serious way progress toward the much needed settlement of irrigation lands and the bringing of these areas into production.

As carried out either by the government or the ordinary private enterprise, even our most complete irrigation projects do not clear the land, level it off into suitable checks, and throw up borders; laterals and boxes are not put in, nor are the best methods of irrigation determined and laid out. But all these detailed improvements, which have to be made before the first crop can be seeded, are quite as essential to the success of the new settler and are often more costly than the canals and reservoirs themselves.

It is, therefore, most unwise to leave all this work, which is not farming but rather engineering, for the inexperienced settler. In his hands it is likely to cost twice what it should and at a time when there is no income from the land the necessity for any considerable outlay may spell failure for the individual. It is men with small capital who are most often attracted to the irrigation projects and these are the men we must continue to attract by making the farming of such land a venture within the reach of limited capital.

Preparing the Land for Cultivation—The average settler knows nothing about preparing land for irrigation and if he goes in and tries to do it alone he is quite likely to be bankrupt, discouraged and thoroughly disillusioned before he plants his first vine or tree. To subdivide and unscrupulously sell tracts of "irrigated lands" to inexperienced settlers who are foredoomed to failure is to prevent the development of our arid territory, not only on the areas so sold but also through the "black eye" which the failures of such projects give to irrigation ventures generally.

Recently we made a study of seventy farms, all of them in irrigated districts. All of them had originally been part of grain ranches and were sold to the farmer as irrigated lands. In almost every case we found that the cost of preparing the surface of the land so that water could be spread over it, putting in the distributing gates and the little laterals, building the house and farm buildings, amounted to more than the cost of the water rights plus the original cost of the land.

To sum up, the preparation of the surface of the land so that water can be distributed over it, the determination of the method by which water is to be distributed, and the placing of facilities on each farm for its distribution is not agriculture, it is engineering, and, if this work is not included in the original construction program, expert advice and direction must be provided to aid the settler in doing it. He ought to be fully informed regarding the total cost before he settles on the land and if he is accepted without capital enough to carry out necessary development work, then credit should be extended him with which to complete it. This is essential because this work must be done before he can get any returns and it must be done quickly or the annual irrigation charges, taxes, interest and payments on his land will insure his financial downfall before he gets started.

Community Co-Operation—Another reason why irrigation projects should be settled quickly is to secure from the outset the advantages of community development. It is very important that the settlers shall at least have access to expert advice and direction as to the kind of stock to buy, the kind of crops to plant, and the methods to use in working together to secure wholesale prices on equipment and the best prices on products.

That all this and more can be successfully done has been demonstrated by the Durham and Delhi colonies in California. These colonies, though small in area, are remolding the methods and ideas of every private colonization enterprise in California and are educating bankers and business men on the real problems of rural life; as an educational agency no part of the state government has been more illuminating.

In the interest of developing our arid lands, prospective settlers must be protected from the owners of large areas who profit most by the sale of partially developed tracts. Those who are interested only in selling land are bitterly opposed to the ideas presented in this article because these ideas mean organization expense and continued responsibility for colonies, both of which have been evaded in the past. Looking at it from the economic standpoint, however, the cost of this advice and direction is not one-tenth what settlers waste and lose when left to work out their own salvation.

It is this waste and loss that has led to the failures so discouraging to settlers, and we cannot expect to continue to be a nation of land owning farmers if we leave men to struggle alone and unaided in the purchase and development of farms. The neglected areas of the East equally with the undeveloped areas of the West afford opportunities for the creation of communities organized to work together in business, agriculture and in social affairs. Communities so organized will get returns far beyond anything to be expected from unorganized communities.

Federal aid should not be given to irrigation projects unless (1) provision is made to protect the settler in

the price he pays for land and (2) to include in that price all the improvements needed to make the farm a going concern. Great harm is done by irrigation projects that go just far enough to give land a deceptive and inflated price and then leave the settler to find out what is lacking in the hard school of experience.

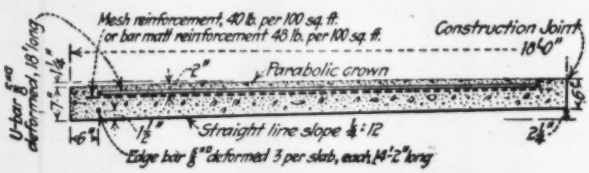
Whenever irrigation projects are carried to the point where a settler can begin as a farmer, or if he is given credit and expert direction so that he can make the land ready for cultivation in an efficient way, and if he is given enough time to make his payments so that the money can be earned out of the land, then there will be no lack of settlers.

The most gratifying feature of the two state settlements in California is the change being wrought in public opinion as to what is needed in the creation of new rural communities and the growing desire that the future development of California shall be carried out under such public direction and by such agencies as will make development the first object to be attained and the selling of land an entirely subordinate feature. The large majority given to the bond issue of the soldier settlement act was largely due to the statement that these settlements would be carried out under the same kind of expert management and personal encouragement that has been so large a feature in the success of the state settlements. Regarded at the outset as an innovation in routine government of doubtful propriety, the vote in favor of its continuance this year shows how the policy has established itself.

New Concrete Road Section for New York

A NEW section, with lighter reinforcement and edges thicker than the center of the slab, has been adopted for New York State concrete roads by Frederick Stuart Greene, commissioner of highways. A half section of the new pavement is illustrated. This drawing gives the crown dimensions for the 18-ft. slab; they are a quarter of an inch greater for the 20-ft. pavement and the same amount smaller for the 16-ft. pavement.

On the top, the slab has a parabolic crown so as to


Mesh reinforcement, 40 lb. per 100 sq. ft.
or bar mat reinforcement 48 lb. per 100 sq. ft.
Construction Joint
18'0"
Parabolic crown
Straight line slope 1/4 : 12
Edge bar 5/8" deformed 3 per slab, each 14'2" long

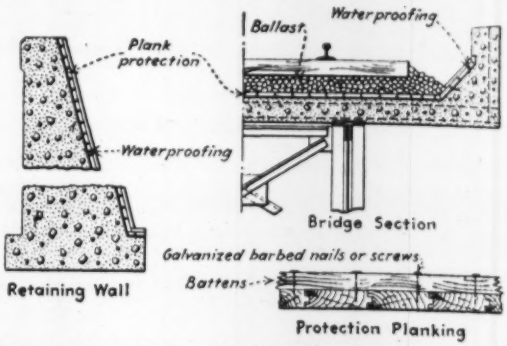
HALF SECTION OF 18-FT. CONCRETE ROAD

Sections for 16-ft. and 20-ft. roads are identical except for crown dimensions. All sections are to be constructed half width at a time. Center line at right.

eliminate the sharp crown intersection of two right planes but the bottom has a straight line slope both ways from the center line. Commenting on the structural strength Commissioner Greene says: (1) We have increased the thickness of the slab at the outer extremities and where the greater strain comes, when two heavily loaded trucks pass each other on the pavement. (2) We have cut down the weight of the reinforcement mesh, using now but 40 lb. per 100 sq.ft. We also give the contractor the option between mesh and assembled bar mats. (3) In addition to U-bars at the expansion joints, we are running longitudinal bars 6 in. from the outer edge of the slab. We are going to place expansion joints at 40-ft. intervals.

Plank Protection for Concrete Waterproofing

TAKING advantage of the excellent results obtained with creosoted timber in railway bridge work, and particular in timber decks carrying ballasted floor, W. R. Roof, bridge engineer of the Chicago Great Western R.R., Chicago, has worked out the application of creosoted planking as a cover or protection layer for waterproofed concrete surfaces. The plank protection in such a construction replaces the concrete or brick protection layers now required. The advantages of the plank protection are saving of weight and cost, ease of application to surfaces of any position or shape, and the



CREOSOTED PLANK PROTECTION FOR WATERPROOFING

Applied to a concrete slab ballasted bridge floor and to a retaining wall.

possibility of simplifying construction work by placing the protection, waterproofing and concrete as a single operation instead of two separate ones. The protection planking can be applied to the back form, the waterproofing then placed against the protection, and the concrete poured against the waterproofing, after which it is only necessary to remove the forms and place the backfill.

Two sketches illustrating the application of this type of protection, to a reinforced-concrete slab bridge floor and to a retaining wall, are shown herewith. They are self-explanatory. The construction has been patented.

Creosoted ballast floor trestles on the Chicago Great Western have been in service for more than a dozen years and are reported to be about as good as when erected. They have 3-in. plank decking carrying 6 in. of broken stone ballast under the ties. In spite of very heavy ballast (E-56) carried on these structures the planking appears to suffer no mechanical damage, and trouble from decay is eliminated by the creosoting. Equally favorable results have been found by other Western roads.

An Estimate of the Cost of London Fog

London Correspondence

It is estimated that five days of fog in London have cost:

Loss to railways, at £40,000 per day	£200,000
Loss on other transport, at £30,000 per day	150,000
Loss of custom by shops, at £100,000 per day	500,000
Deterioration of stock in shops, warehouses, stores, factories, etc., at £100,000 per day	500,000
Deterioration of curtains, wallpaper, upholstery, linen, etc., in houses, at £25,000 per day	125,000
In hotels, etc., at £10,000 per day	50,000
Loss of working hours, at least £20,000 per day	100,000
Extra lighting at £20,000 per day	100,000
Total	£1,725,000

Rock Boring Mollusks Attack Concrete Pile Jackets

Unusual Occurrence of These Clams in Los Angeles and San Diego Harbors Augments Marine Piling Protection Fight

Extract practically in full of a preliminary report from C. A. Kofoid and Robert C. Miller for the biological section of the San Francisco Bay Marine Piling Committee to the American Wood Preservers Association at the New Orleans meeting Jan. 23, 24 and 25.

ROCK boring mollusks of the family *Pholadidae* are commonly distributed along the Pacific Coast, several species occurring in suitable habitats from Alaska south to San Diego and beyond. It has often been supposed that concrete in sea water might be subject to attack by such borers which penetrate rocks of a number of different kinds and often of considerable hardness, but, as mentioned in the first report of this committee (p. 24), no specific instances of the occurrence of these organisms in concrete marine structures have heretofore been reported. Hence the data presented below are of unusual interest to both biologists and engineers.

The writers wish to express their indebtedness to D. E. Hughes, of San Pedro, who first discovered the borers in concrete, for calling the matter to their attention and assisting in the collection of specimens and data. Invaluable assistance was also rendered by J. W. Ludlow, Los Angeles harbor engineer, W. R. Sadler, city chemist, and others.

In the work of widening the channel in Los Angeles Harbor, Nov. 13, 1922, it became necessary to remove some wooden piling which had been jacketed some years previously with concrete. In looking over these piles Mr. Hughes observed that some of the jackets had been attacked by borers, and investigated further. Of eighteen jackets examined under the old Fish Cannery wharf, opposite the foot of Fifth St., San Pedro, sixteen were found to be more or less attacked; five were considered to be badly attacked (six borers or more per square foot of exposed surface); the others contained fewer and some only an occasional borer. The two jackets which did not contain borers stood in shallower water than the others.

The exact date at which these piles were driven could not be determined, but it was probably several years prior to 1908, at which time it became necessary to jacket them with concrete to protect them from *Limnoria* or other wood borers. The jackets had accordingly been in place fourteen years. The length of time during which they were actually exposed to attack by the rock borers, however, is probably considerably less than this as the form lumber was left in place outside the jackets and would deter the pholad borers from entering until the forms were destroyed by wood borers.

One of these piles was examined a month later by Mr. Miller. The jacket was 7 ft. long, and extended from mud line up to mean low water. It consisted of a fairly good mortar concrete, averaging 2½ in. in thickness and so hard that some difficulty was experienced in breaking it up with a 15-lb. iron bar to secure samples.

The outside form lumber was still partly in place. It had originally consisted of 1-in. redwood, as seen at one place where it had been protected by a cleat. Elsewhere it had been badly attacked by *Limnoria* and *Teredo diegensis* so that only a thin shell of it remained adhering to the concrete. This thin layer of wood, however, still covered all of the jacket except about one foot at the top, and one corner, where the form had sprung apart leaving a gap through which the rock borers could enter. The entire surface exposed to rock borers was not more than 5 sq.ft. In this area nearly forty of the borers occurred, averaging seven or eight to the square foot.

The borers were in general a little larger than a man's thumb. The largest one found occupied a burrow measuring 1⅜ in. in diameter at its widest portion. Two borers in this jacket had penetrated the concrete until they came in contact with the wood within but none had actually bored into the wood. One indeed had turned and continued boring in the concrete parallel to the surface of the wood, to avoid entering the latter.

FIG. 1—ROCK BORING CLAMS FOUND IN CONCRETE PILE JACKETS

Sample contains three borers in a space 3 in. square. Two are visible, the third being indicated by opening near the lower margin of photograph.

Mr. Hughes reported that of the jackets examined by him one other was attacked more heavily than the one noted above in proportion to the surface exposed, but the jacket consisted of a very poor concrete, badly disintegrated.

The discovery of the borers in concrete at this locality led to an examination of other concrete jacket piles in the harbor.

Mr. Ludlow stated that of twelve pile jackets examined by him at the old Blinn Lumber Co. wharf, opposite berth 229 in Los Angeles Harbor, three were rather badly attacked by borers. Mr. Sadler reported that he had broken open twelve concrete jackets at the First St. ferry landing, of which three were found to be attacked, one quite badly, the others containing from three to six borers each. Of seventy-five jackets examined by Mr. Sadler at the Kerckhoff-Cuzner wharf, about 50 per cent were found to contain borers and about 20 per cent were quite badly attacked.

Mr. Miller had the privilege of going over this ground again with Messrs. Hughes, Ludlow and Sadler on Dec. 18. A number of other jackets were broken open and a quantity of specimens secured.

The species occasioning most of the damage was found to be *Pholadidae penita* Conrad, known commonly as the "rock clam." It occurred from 2 ft. above mean low water to 1 ft. below, which was the lowest we were able to work. It doubtless similarly occurs on down to the mud, even in deep water, as it has been dredged in San Francisco Bay at a depth of 50 fathoms. (See Packard, E. L., Molluscan Fauna from San Francisco Bay. Univ. Calif. Pub. Zool., vol. 14, p. 288.) This borer, unlike *Teredo*, has the body entirely enclosed within the two valves of the shell, which are ovate, tapering somewhat posteriorly and ending in leathery flaps. During the period of active boring life the foot protrudes through a rather large anterior gape between the valves, but after cessation of boring, and perhaps in the interim between periods of boring activity, this gape is closed over by a calcareous plate, giving the borer the appearance seen in the photograph. The anterior portion of the shell is ribbed and somewhat denticulated either for rasping purposes or to grip the sides of the burrow.

This species is edible and is used for food in localities where it occurs in sufficient abundance to make worth while the labor of removing it from its rocky domicile, which is usually done by means of iron bars.

Another boring species found in concrete pile jackets here was *Platyodon cancellata* Conrad, a near relative of the soft-shelled clam (*Mys arenaris*). This form inhabits normally stiff mud and clay. It was found in pile jackets only sparsely and in very poor concrete.

A third species occurring in the concrete jackets was the so-called "nestler" *Petricola carditoides* Conrad, which is believed not to bore on its own account but only to inhabit natural cavities or holes bored by other organisms.

As regards the extent of the damage occasioned by borers in concrete, a review of the data assembled by Messrs. Hughes, Ludlow, Sadler and Miller indicates that of concrete jacketed piles at four different locations in Los Angeles Harbor—in fact, at every point in the inner harbor where such piles exist—about 50 per cent have been more or less attacked, of which rather more than one-fifth have been very considerably bored. Of those not attacked, a number stood so well inshore as to be but little exposed to the action of the borers. If all such piles were eliminated from the count, the percentage of jackets damaged would be considerably higher.

These jackets were in general of a medium grade of mortar concrete, some being decidedly poor, others fairly hard. The fact that some of the jackets had given service in sea water over a period of fourteen years indicates a composition as good as that of much of the concrete used for such purposes. Samples of the best mortar in which borers were found showed an air penetration of $\frac{1}{16}$ in. in seven weeks when tested with phenolphthalein.

A. A. M. Russel, testing engineer to the State Harbor Board, has made a crushing test of a sample of one of these jackets, finding the crushing strength of a specimen $2\frac{1}{2}$x$3\frac{1}{2}$x$4\frac{1}{2}$ in. high to be 1,726 lb. per square inch. Mr. Russel thus reports grading of aggregate:

Screen	Per Cent Retained
10- 20	1.78
20- 30	0.89
30- 50	4.46
50- 80	51.78
80-100	16.07
100-200	16.07
Pass 200	8.94

Whether or not concrete of greater hardness and a better assorted aggregate would be similarly subject to borer attack remains to be seen. It has commonly occurred in jacketing piles that the concrete has been "drowned," either by the presence of too much water in the mix, or by depositing the material in water, causing segregation and laitance and rendering such structures especially susceptible to borer action. The probabilities of attack on well-made precast piles of other high-grade concrete structures hinge upon whether the action of the borers is mechanical or chemical, evidence accumulated tends to favor the latter view. If the action is mechanical, hardness of the concrete may be expected to prove a deterrent, but if it be chemical, density of material will probably only serve to make the boring more slow.

The fact that borers have not as yet been reported in concrete marine structures in San Francisco Bay is not regarded as signifying that such structures are permanently immune in this locality but only that they have not thus far been much exposed to borer attack. The shores of San Francisco Bay in general are gently sloping mud flats, and, except in the immediate neighborhood of the Golden Gate, rocks affording suitable habitats for phold borers are extremely rare. The occurrence of such borers about the Golden Gate, however, indicates this as a possible source of future infection for concrete structures within the bay.

The findings set forth above are, to say the least, disturbing, and indicative of serious possibilities. It is entirely to be expected that, when rock borers have penetrated the concrete jacket about a wooden pile, wood borers will be able to gain entrance through the pholad holes and attack the pile itself. There is also a more serious possibility in the case of reinforced concrete piles; a single borer penetrating such a pile would let water in to the reinforcing metal, which would effect corrosion and swelling of the latter, causing the pile to crack and speedily disintegrate. It appears, at any rate, that the use of concrete for marine construction is not so immediate and certain a solution of the marine borer problem as has sometimes been assumed to be the case. Engineers will await with much interest further observations on the permanence of concrete in sea water, as affected by borer action.

Copper Sulphate Keeps Down Najas Gracillima

A recent unusual experience with plant growth in reservoirs at the Trap Falls Reservoir of the Bridgeport (Conn.) Hydraulic Co., has been reported to this journal by J. Frederick Jackson, director, Bureau of Engineering, Connecticut State Board of Health, as follows: "Dr. Barrows of the company named saw a strange filamentous growth floating in the shallow portions of the reservoir. It accumulated rapidly and in detached bunches floated to the center. In one instance it reached the intake and, collecting on the screens, broke them. Raking it out and burning it on the shores was tried but it would not burn readily. Finally, S. G. Senior, general manager of the company, suggested copper sulphate treatment. By using concentrated doses this kept down the growth. A specimen was submitted to Dr. G. B. Clinton, botanist at the Connecticut Agricultural Experiment Station, who identified it as *Najas Gracillima*, a near relative of eel grass. Its noninflammability is due to much salt in it."

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Two Notable Books on City Planning

THE LAW OF CITY PLANNING AND ZONING — By Frank Backus Williams, A.M., LL.B., of the New York Bar. [The Citizen's Library of Economics, Politics and Sociology, New Series.] New York: The Macmillan Co. Cloth; 6x9 in.; pp. 738. $5.

THE PLANNING OF THE MODERN CITY: A Review of the Principles Governing City Planning—By Nelson P. Lewis, M. Am. Soc. C. E., M. Am. City Planning Inst., formerly Chief Engineer of the Board of Estimate and Apportionment of New York City. With the Assistance of Harold M. Lewis, M. Am. Soc. C. E. Second Edition Revised. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6x9 in.; pp. 457; 87 plates and 62 figures and diagrams in the text. $5.

The slightness of the revision of Mr. Lewis' notable book on city planning leaves it substantially as it was when first published in 1916 but it was so fundamentally sound that its new edition, taken with the widely-ranging new text by Mr. Williams, presents a comprehensive up-to-date review of the field of city planning.

After chapters on Scope, Fundamentals and Planning the City as a Whole, Mr. Williams takes up Planning the Public Features under Acquiring the Land; Excess and Zone Condemnation and Replatting in (a) Europe and (b) the United States; Public Utilities and the Water Front; Streets, Setbacks and Traffic Regulations. Under Planning the Private Features there are chapters on Zoning in (a) Europe and (b) Canada and the United States. A short chapter on City Planning Finance is followed by three chapters on Planning Administration in (a) Italy, Sweden and Germany; (b) England, Canada and France; (c) the United States. A Bibliography of 25 pp., Tables of Statutes, Indexes of (a) Cases and (b) Statutes and a General Index close the book.

Mr. Williams' long and thorough studies of city planning in general and the law of the subject in particular, the latter including constitutional authorizations and limitations, statutory law and city ordinances, have eminently fitted him for an ambitious task ably executed. Besides the law of city planing and zoning the author exhibits the fundamental objects and principles of each and reviews the history of both. He also presents many valuable data on municipal taxation and finance, useful to the engineer and the lawyer, as well as to students of municipal government.

The first edition of Mr. Lewis' admirable book was favorably reviewed in these columns Sept. 21, 1916, p. 552. The aim and spirit of the book is well indicated by its dedication, which reads: "To the Municipal Engineers of the United States, the First Men on the Ground in City Planning as in City Building, in the Hope That It May Help Them To Realize Their Responsibilities and Opportunities in Determining the Manner in Which Our Cities Develop."

Apparently there are few changes in the text of the present edition until p. 282 is reached. At that point and later in the same chapter a little new matter on zoning is added, chiefly on the New York City Zoning Regulations of 1916. The other material addition to the body of the book is the chapter, The Environs of the City, where a few pages on the Russell Sage Foundation studies for the Plan of New York and Environs have been inserted. Two appendixes have been added: one of 3 pp. on Control of Subdivision Plans (New York City and State) and one of 16 pp., reprinting the New York City Zoning Regulations of 1916. Besides the slight text changes and additions "there are," according to the Preface, "a few cases where more timely or better plans or views have been substituted" and the "index has been enlarged and improved."

If both these books were on the shelves and frequently in the hands of every municipal engineer it would be greatly to the advantage of the cities they serve; for at last we have reached the city planning era and it behooves every municipal engineer to act accordingly.

A "Filtration" Primer

FILTRATION: An Elementary Treatise on Industrial Methods and Equipment for the Filtration of Liquids and Gases for Those Concerned with Water Supply, Ventilation, and Public Health; Chemists, Mechanical Engineers and Others. London and New York: Sir Isaac Pitman & Sons, Ltd. Cloth; 4 x 6 in.; pp. 102; illustrated. 2½s. 85c.

Within the limited space available in the "Technical Primers" series of which this booklet is one, the author has given a good general idea of the chief methods employed in British industrial arts for the removal of foreign matters from liquids and gases—chiefly water, oil and air. Potable water is given some space, but the author frankly states that his own experience has been in the industrial field. "Filtration" is used broadly to cover sedimentation, chemical precipitation, coagulation, straining, centrifuging, vacuum and plate filter pressing, and water filtration of both the slow and mechanical types. The treatment is chiefly descriptive. Mechanical filtration is given more space and favor than slow sand filtration, but the treatment does not reflect the state of the art of either type, at least not in America. This is particularly true of what the author says regarding the American type of mechanical filter, which harks back to the circular tank design of two decades or more ago and ignores the rectangular concrete tanks in multiple with combined capacities running to 100 to 200 m.g.d or more at a single installation.

New Publications of the U. S. C. & G. S.

The following pamphlets have recently been published by the United States Coast and Geodetic Survey and may be obtained from the Superintendent of Documents, Washington, D. C., for the prices given in parenthesis after each title:

Study of the Time Errors in Precise Longitude Determinations by the U. S. Coast and Geodetic Survey. (5c.)
An Investigation of the Latitude of Ukiah, Calif., and the Motion of the Pole. (15c.)
Precise Leveling in Texas. (15c.)
Precise Traverse Racine, Wis., to Vandalia, Ill. (15c.)
Utah-Washington Arc of Precise Triangulation. (15c.)
California-Oregon Arc of Precise Triangulation. (10c.)
Precise Triangulation in Texas, Rio Grande Arc. (15c.)
Triangulation in Massachusetts. (30c.)

Whipple's Vital Statistics Revised

VITAL STATISTICS: An Introduction to the Sciences of Demography—By George Chandler Whipple, Professor of Sanitary Engineering in Harvard University, Member Public Health Council, Massachusetts State Department of Health. Second Edition. Flexible; 5 x 7 in.; pp. 579; 89 line cuts. $4 net.

In this edition of Professor Whipple's valuable work, population tables have been revised to include the 1920 census figures and some tables have been added. There is also a new chapter on estimating future population which makes use of semi-log paper and includes diagrams of population growth in various parts of the country. In addition, the international classification of causes of death has been revised in accordance with the changes made at Paris in 1920. Since the first edition appeared in 1919 (see *Engineering News-Record*, June 19, 1919, p. 1216) the book has been translated into Japanese. Translations into Italian and Spanish are being made. Assistance in revision is credited to Dana E. Kepner, assistant in sanitary engineering, Harvard University.

Material Handling and Storage

REVIEWED BY HAROLD T. MOORE
Industrial Engineer, Day & Zimmerman, Inc., Philadelphia, Pa.

THE MECHANICAL HANDLING AND STORING OF MATERIAL—By George Frederick Zimmer, A.M. Inst. C.E. New York: D. Van Nostrand Co. Edinburgh: The Darien Press. Cloth; 8 x 11 in.; pp. 804; half tones and line cuts. $15 net.

The present edition of this comprehensive work aims primarily to bring to date a presentation of British methods and equipment for the handling and storage of materials but includes American practice where it is either on a larger scale or otherwise distinct from European methods. Mr. Zimmer, who has had wide experience with material handling problems and who far many years has been accumulating data on handling and storage equipment, is eminently qualified in this subject.

In the foreword by John Purser Griffith, past president of the Institute of Civil Engineers, special reference is made to the substitution in the last two editions of the term "labor aiding" and "time saving" appliances in preference to the more familiar expression "labor saving" appliances. The attitude of the English working classes against the introduction of improved machinery is deplored by Mr. Zimmer as being a handicap to commercial and technical progress.

Under Continuous Handling of Material, the following subjects are discussed and illustrated in considerable detail: Bucket elevators for materials in bulk, tray and finger elevators for large objects, conveyors of such well known types as screw, push-plate or scraper, belt, slat, pan, apron, pickling, reciprocating, gravity bucket, etc. A discussion of power consumption, speed and wear is included, with chapters devoted to the handling of hot coke in gas works, coal face, special purpose and gravity conveyors, casting machines, and automatic feeding devices. Pneumatic and hydraulic handling systems are described, together with the mechanical ejection of ashes from steamers. Under Intermittent Handling of Material, the sub-divisions include endless rope and chain haulages, aerial rope- and cableways, coaling vessels at sea, monorails and telphers, blast furnace skips, ore-handling plants, and coke handling devices. The chapters assigned to "unloading and loading appliances" describe self-dumping buckets, grabs, lifting magnets, the Hulett unloader, traveling, cantilever and monorail cranes, dock-leg and floating elevators. Portable conveyors, bucket elevators, and stacking machines are also described.

The transportation section takes up self-emptying railroad cars, automatic railways, car dumpers, and mine tipples. The coaling of ships is explained and illustrated by floating elevators, belt conveyor feeders in conjunction with traveling delivery towers, portable dock-legs, skiphoists, etc. Locomotive coaling stations, coal, coke and ash handling installations for boiler plants and gas-works, as well as coal and ore storage and recovery systems and the warehousing of grain, are fully covered. A number of automatic weighing devices for continuous or intermittent use are discussed. A useful table of weights of various materials gives pounds per cubic foot, cubic foot per ton and pounds per bushel.

The book contains a classified trade directory of British manufacturers of handling and storing equipment. It also includes historical references to ancient methods of handling by manual labor as well as evolutionary steps leading up to modern methods and machinery. The work is more descriptive than statistical, covering numerous varieties of installations with a large number of excellent illustrations. The author aims to present what has been accomplished and is in practical use and while his commendable book includes numerous mechanical details, it only partially covers the economics of handling or the comparative advantages of different types of equipment.

Summarizing, the work is a voluminous but worthy general treatment of its subject presented in an interesting but somewhat diffuse style, and discusses types of equipment rather than general principles. It contains much information of use to the designer and plant operator but as it deals mostly with British and European practice it is of more value to the English than the American engineer.

Height Zoning Facts and Opinions

STUDIES ON BUILDING HEIGHT LIMITATIONS IN LARGE CITIES. With Special Reference to Conditions in Chicago: Proceedings of an Investigation of Building Height Limitations Conducted Under the Auspices of the Zoning Committee of the Chicago Real Estate Board—Compiled by Charles M. Nichols. Chicago: Real Estate Board. Cloth; 6 x 9 in.; pp. 299; folding map in colors and a few diagrams and half tones. $2.60 postpaid.

Valuable data and a large body of opinion on height zoning are included in this volume. Naturally, most of the contents relate to Chicago. A considerable amount of space is occupied by a series of talks and answers to queries by Edward M. Bassett, New York expert on the legal aspects of zoning. Dr. W. A. Evans, formerly health commissioner of Chicago, and Charles B. Ball, engineer-sanitary inspector of the Chicago Health Department, contributed talks on the relation of building heights to health. A number of prominent Chicago realtors participated in the conferences reported. A notable outcome of the investigation was a committee report, approved by the Chicago Real Estate Board, recommending a lower-scale of heights for Chicago buildings than had been proposed by the Chicago Zoning Committee. The value of the report would have been increased by a judicious summary of its contents.

A Wood-Preservers Journal

The American Wood Preservers Association, Otis Building, Chicago, has issued the first number of its new official periodical, the "Wood Preserving News." It is a 24-page pamphlet, with numerous items of news and various short articles. Some of the contents of this number are quoted from *Engineering News-Record*.

Airplane Photographic Mapping

THE FACE OF THE EARTH AS SEEN FROM THE AIR: A Study in the Application of Airplane Photography to Geography —By Willis T. Lee, U. S. Geological Survey. New York: American Geographical Society. Cloth; 7 x 10 in.; pp. 110; 82 illustrations, mostly half-tones, including folding plates. $4.

Use of airplane in mapping for military purposes is, of course, well established. As an adjunct of the engineer its position is becoming recognized. Yet the general knowledge of airplane photography's application to engineering is perhaps understood only in its broadest principles. It is a new art with little bibliography. For that reason "The Face of the Earth as Seen From the Air" is timely. The utility of air photography not only in reconnaissance work, but as a check against precise plane and topographic surveying is easily understandable from this volume. The book compares maps made on the ground with the same territory mapped from the air, making intelligible to even the casual reader what an aid to the surveyor and engineer the airplane is. Material from which the book was compiled represents the work of both the U. S. Army and U. S. Navy Air Services. The reliability of these agencies gives to a volume on a new subject an authenticity that recommends it to any and all engineers who are interested in the airplane as an aid to their work.

PUBLICATIONS RECEIVED

New Books and Revised Editions

ACCOUNTING AND COST KEEPING OF DEPARTMENT OF ENGINEERING AND CONSTRUCTION: Technical Reports, Part IX, Miami Conservancy District, Dayton, Ohio—By F. L. Cavis, Chief Accountant. Paper; 6x9 in.; pp. 112; map and 31 accounting forms. 75c. net.

Detailed description of the well-conceived accounting system used on one of the most important engineering construction jobs of the last decade. A short appendix discusses Cost-Plus Variable-Fee Contracts and reprints some paragraphs from one such a contract on the Miami District work.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION: Proceedings, 1922. Chicago; cloth, 6x9 in.; pp. 278; illustrated. $1.

The principal papers include the reconstruction of the Ohio River bridge of the Cincinnati Southern Ry. at Cincinnati; framing bridge timbers before treatment; labor saving devices; painting structural steel; building inspection; driving and handling wood and concrete piles; sewers and drains; wood, steel and concrete tanks.

AMERICAN SOCIETY FOR TESTING MATERIALS: INDEX TO PROCEEDINGS, VOLUMES XIII TO XX (1913-1920). Address the Society (as above) at 1315 Spruce St., Philadelphia, Pa. Cloth; 6x9 in.; pp. 189. $2.50 in cloth; $3.50 in half leather.

BUSINESS LAW JOURNAL: Vol. I, No. 1. New York: The Business Law Journal Co., 71 Murray St. Paper; 6x9 in.; pp. 84. 75c. a copy; $8 a year.

CONCRETE CONSTRUCTION FOR ARCHITECTS: A Concise Treatise on the Design of Reinforced Concrete Slabs, Beams, Girders, Columns and Footings, and a Description of the Actual Design of a Concrete Building Involving the Use of Flat Slab Construction—By DeWitt C. Pond, Author of "Engineering for Architects." New York: Charles Scribner's Sons. Cloth; 6x9 in.; pp. 203; 89 line cuts. $4.

COUNTY AND TOWNSHIP GOVERNMENT IN THE UNITED STATES—By Kirk H. Porter, Ph.D. Assistant Professor of Political Science, State University of Ohio. New York: The Macmillan Co. Cloth; 6x8 in.; pp. 361. $2.25.

CREATIVE SELLING: Making and Keeping Customers—By Charles Henry Mackintosh. New York and London: D. Appleton & Co. Cloth; 5x8 in.; pp. 183. $1.50

DIE METHODE DER FESTPUNKTE zur Berechnung der statisch unfestiumten Konstruktion mit zalreichen. Beispielen aus der Praxis insebondere ausgeführten Eisenbetontragwerken—Von Dr. Ing. Ernst Suter. Berlin: Julius Springer. Paper; 7x10 in.; pp. 734; 591 line cuts.

EXPERIMENTS ON LOSS OF HEAD in Valves and Pipes of One-Half to Twelve Inches Diameter—By Charles Ives Corp, Professor of Hydraulic and Sanitary Engineering, Assisted by Roland O. Ruble, Instructor in Hydraulic Engineering. Madison: University of Wisconsin Experiment Station. Paper; 6x9 in.; pp. 143; line cuts. 75c.

HANDBOOK OF STEEL ERECTION—By M. C. Bland, M. Am. Soc. C. E., M. Am. Soc. M. E., Bridge and Structural Engineer, Harrisburg, Pa. New York and London: McGraw-Hill Book Co. Flexible; 4x7 in.; pp. 241; 39 line cuts and half tones. $2.50.

OPTICAL METHODS IN CONTROL AND RESEARCH LABORATORIES—By J. N. Goldsmith, S. Judd Lewis, F. Twyman. Vol. I: Spectrum Analysis, Absorption Spectra, Refractometry Polarimetry. Second Edition, Enlarged. London: Adam Hilger, Ltd. Limp Cloth; 6x10 in.; pp. 55; illustrated. 1s. 8d.

PLANE TABLE MANUAL—By D. B. Wainwright, Hydrographic and Geodetic Engineer. Washington, D. C.: U. S. Coast & Geodetic Survey. Paper; 5x8 in.; pp. 97; 48 illustrations, mostly line cuts. Free on application to the Survey; 25c. from Superintendent of Documents.

A revised edition of the Coast Survey's manual of instructions for making topographical surveys with the plane table. Also contains interesting historical notes and illustrations.

POLITICS: An Original Investigation Into The Essential Elements and Inherent Defects Common to All Present Forms of Government Together With a Proposal For a Political System Which Will Automatically Produce the Best Government Possible in Any Given Community—By Frank Exline. New York: E. P. Dutton & Co. Cloth; 6x8 in.; pp. 226. $2.

PRACTICAL FACTORY ADMINISTRATION—By Matthew Porosky, Chairman Factory Management Committee, and Member Executive Committee, the Holtzer-Cabot Electric Company; Instructor in Factory Administration, Northeastern University, School of Commerce and Finance. New York and London: McGraw-Hill Book Co. Cloth; 6x8 in.; pp. 244; 51 line cuts. $2.50.

Designed for executives, salesmen, foremen, cost accountants and students of factory and business administration. The "principles, practices and forms outlined are presented from the viewpoint of the average rather than the large establishment." Among other things takes up buildings, handling materials and cost systems.

PUBLIC FINANCE—By M. E. Robinson, Fellow and Lecturer of Newnham College, Cambridge. With an Introduction by J. M. Keynes. [Cambridge Economic Handbooks.] New York: Harcourt, Brace & Co. Cloth; 5x8 in.; pp. 172. $1.25.

ROBERT FULTON AND THE SUBMARINE—By Wm. Barcley Parsons. New York: Columbia University Press. Cloth; 7x10 in.; pp. 154; self-portrait frontispiece and other plates, mostly reproductions of Fulton's drawings. $4.

THE ENGINEERING OF EXCAVATION—By George B. Massey, M. Am. Soc. C.E., Western Soc. Engrs., A. A. E., Consulting Engineer, Vice President, Randolph-Perkins Co. New York: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. 376; 196 half tones and line cuts, some of the latter on folding plates. $6. 30s. net.

VORLESUNGEN UBER EISENBETON—Von Dr.-Ing. E. Probst, ord. Professor an der technischen Hochschule in Karlsruhe. Zweiter Band. Anwendung der Theorie auf Beispiele im Hochbau, Bruckenbau und Wasserbau—Grundlagen für die Berechnung und das Entwerfen von Eisenbetonbauten—Allgemeines über Vorbereitung und Verarbeitung von Eisenbeton—Richtlinien für Kostenermittlungen—Architektur im Eisenbeton—Amtliche Vorschriften. Berlin: Julius Springer. Cloth; 7 x 10 in.; pp. 640; 71 line cuts and half tones.

WATERWORKS FOR URBAN AND RURAL DISTRICTS: With Notes on the Supply for Mansions and Isolated Buildings—By Henry C. Adams, M. Inst. C. E., etc., Consulting Engineer. London and New York; Isaac Pitman & Sons: Cloth; 6x8 in.; pp. 230; 115 illustrations, including three folding plates. 15s. $4.50.

Reports and Pamphlets in Various Fields

CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING: Annual Report of the President (H. S. Pritchett) and Treasurer, 1922—New York City. Paper; 8x10 in.; pp. 211.

President Pritchett's report contains 3 pp. on "The Extraordinary Rise of College Salaries" and 24 pp. on "The Rising Cost of Education." The latter deals chiefly with public schools rather than colleges. The ground is taken that the increasing burden of school taxes is a menace to free education because it may result in a curtailment of school funds. The burden is attributed largely to the teaching of unessential subjects and to an unwise expansion of trade and professional courses in the public schools.

CONNECTICUT PUBLIC UTILITIES COMMISSION—Report for 1921. Hartford, Conn. Cloth; 6x9 in.; pp. 765.

DIVISION OF ENGINEERING AND IRRIGATION: California Department of Public Works: Report for 1921-22—W. F. McClure, Chief of Division, Sacramento. Paper; 6x9 in.; pp. 58; half tones.

EDUCATION FOR HIGHWAY ENGINEERING AND TRANSPORT; Proceedings of Conference at Washington, D. C., Oct. 26-28, 1922, Under the Direction of the Highway Education Board—Edited by Walton C. John, Executive Secretary, Willard Building, Washington, D. C. Paper; 6x9 in.; pp. 246.

HIGHWAY RESEARCH PROJECTS IN THE UNITED STATES: Results of a Census by Advisory Board on Highway Research, Division of Engineering, National Research Council, in Cooperation with the Bureau of Public Roads, U. S. Department of Agriculture, by William Kendrick Hatt, Director, Advisory Board. October *Bulletin* of the National Research Council of the National Academy of Sciences, Washington, D. C. Paper; 7x10 in.; pp. 103.

Classified list of research work, by states, with other information.

INDIANA STATE BOARD OF REGISTRATION FOR PROFESSIONAL ENGINEERS AND LAND SURVEYORS: Report and Roster, 1921-22. Indianapolis. Paper; 6x9 in.; pp. 47; illustrated.

The first printed report of such a board that has come to our attention. Reviews work of board and gives list of registered engi-

neers, with business and residence addresses, branch of engineering and section of Act governing registration. Contains map of United States showing registration boards, with kinds of registration, revised in November, 1922.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS: Proceedings, 1922—Secretary, A. M. Anderson, 10 South La Salle St., Chicago, Ill. Paper; 8x11 in.

MAINE HIGHWAY COMMISSION: Report from Jan. 1, 1921, to June 30, 1922—Augusta. Paper; 6x9 in.; pp. 67; folding map.

MISSOURI HIGHWAY COMMISSION: Report for 1922—Jefferson City. Cloth; 6x9 in.; pp. 237; maps and half tones.

MODULING OF IRRIGATION CHANNELS—By E. S. Crump, Executive Engineer, Public Works Department, Punjab Irrigation Branch, Lahore, India. Public Document. Paper; 9 x 13 in.; pp. 9; folding plates.

A module is here defined as "a device arranged to pass a supply of water independent of water-surface level in channel into which the supply is delivered." Two classes of modules are reviewed: (1) rigid, or those passing a fixed supply; (2) flexible, those "passing a supply which varies, in some characteristic manner, with surface level in the supply channel, divided into (a) orifice, (b) weir or flume, and (c) combination of (a) and (b)."

NEW HAMPSHIRE HIGHWAY DEPARTMENT: Report for 1920-22—Concord. Cloth; 6x9 in.; pp. 143; half tones.

PLAN OF NEW YORK AND ITS ENVIRONS: Report of Progress, May, 1922—February, 1923. Address Plan of New York and Environs, 130 East 22nd St., New York City. Paper; 6x9 in.; pp. 67.

Gives personnel of committee and staff. Reviews work under the four heads, physical, economic, social nad legal, the physical section being by Nelson P. Lewis, consulting engineer. Contains a preliminary report by the noted British town planner, Raymond Unwin, on New York and Environs as a Regional Planning Problem from the European Point of View, written after a visit to New York for conference purposes. Announces an expected report from Jacques Lambert of Paris.

REPRINT OF FIVE ARTICLES RELATING TO BALTIMORE'S SEWAGE SYSTEM—Baltimore, Md.: Sewer Division, City Hall. Paper; 6x9 in.; pp. 37; line cuts.

Three articles by M. J. Ruark, division engineer of sewers, and two by C. E. Keefer, assistant designing engineer on sewer design and maintenance, enlargement of sewer-works and sludge treatment, from *Proceedings* Am. Soc. M.I., *Engineering News-Record* and *Public Works*, originally printed in 1921-22.

SASKATCHEWAN DEPARTMENT OF HIGHWAYS: Report for 1921-22—Regina. Paper 7x10 in.; pp. 99; half tones.

SPECIAL TAXATION FOR MOTOR VEHICLES: (1) Sound and Equitable Principles for Motor Vehicle Taxation. (2) State Taxes in Force Jan. 1, 1923. (3) Total Amount of Taxes Paid in 1921. New York: Motor Vehicle Conference Committee, 366 Madison Ave. Paper; 6x9 in.; pp. 24.

SPECIFICATIONS FOR PETROLEUM PRODUCTS AND METHODS OF TESTING—Federal Specifications Board, Revised Oct. 31, 1922. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp. 88; line cuts.

STANDARDIZING SALARIES—Prepared by J. B. Probst, Chief Examiner, Civil Service Bureau, St. Paul, Minn. Paper; 6x9 in.; pp. 8.

States principles and gives basic salary rates for eight grades of service with 1916 as 100, together with 1921 percentages, increases for the annual adjustment to accord with living costs.

SURFACE WATER SUPPLY OF CANADA: British Columbia and Yukon Territory, Climatic Year, 1920-21—Ottawa: Dominion Water Power Branch. Paper; 7x10 in.; pp. 197; folding map.

SURVEY OF CITY AND REGIONAL PLANNING IN THE UNITED STATES, 1922: With a List of Plan Reports, 1921-22—By Theodora Kimball, Librarian, School of Landscape Architecture, Harvard University. Reprinted from *Landscape Architecture*, January, 1923. Paper; 6x9 in.; pp. 20.

Twenty-seven cities are listed as being the subject of city plan reports in 1921-22; some have from two to five entries.

THE SWEDISH YEAR BOOK, 1922—Edited and Published with the Assistance of Public Authorities—Stockholm: Royal Foreign Office. New York City: Royal Consulate General of Sweden, 70 East 45th St. Flexible Cloth; 5x8 in.; pp. 253; illustrated. Covers succinctly and interestingly the arts, industries, commerce, government, etc., of Sweden.

TRAFFORD PARK: Britain's Workshop and Storehouse—Manchester, England: Trafford Park Estates, Ltd. Stiff paper; 8x11 in.; illustrated with folding colored map, half tones, etc.

Describes storehouses, industrial sites, existing industries, docks, railway facilities, etc., on a thousand-acre tract between Manchester Ship Canal and Cumberland Canal.

TYPICAL ABUSES IN HANDLING MUNICIPAL BONDS: Proposing a Bond Service for Bond Buyers, Bond Bankers and Bond Issuers. New York: Committee on Non-Partisan Facts of the Institute for Public Service, 1125 Amsterdam Ave. Paper; 5x7 in.; pp. 32.

VENEZUELA MEMORIA OBRAS PUBLICAS—Annual Report—Caracas. Two volumes; paper; 9x12 in.; pp. 559 and 740; line cuts and half tones.

VERMONT SOCIETY OF ENGINEERS; Proceeding, 1922—Paper; 6x9 in.; pp. 24.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Mr. Hoover's Remarks and Society Co-operation

Sir—In *Engineering News-Record*, Feb. 1, 1923, p. 227, and in *Bulletin* No. 2 of the Federated American Engineering Societies, an account is given of some remarks made by Mr. Hoover at a luncheon in Washington to Charles F. Loweth, the new president of the American Society of Civil Engineers. These remarks seem to me to call for some comments, and possibly I may as well make them as anybody else.

Let me say at the beginning that I have a great admiration for Mr. Hoover, that I am proud and happy that an engineer is a member of the President's cabinet, and that I am glad Mr. Hoover is that member. This does not mean, however, that I necessarily approve of everything that Mr. Hoover says or does. Like all the rest of us, he is not infallible.

Mr. Loweth had stated at this luncheon, as reported in *Engineering News-Record*, that "if the American Society of Civil Engineers should not arrange to co-operate through the American Engineering Council, the organization itself would make arrangements for close co-operation with the government." He meant by this that if the American Society of Civil Engineers should not join the Federation, the society would nevertheless co-operate fully with the Federation and with Mr. Hoover.

These remarks of Mr. Loweth led Mr. Hoover "with more than his usual earnestness" to make some statements which seem open to criticism. He said that the American Society of Civil Engineers "should not raise secondary questions when that course interferes with engineers as a whole doing their duty to the country" (Federation *Bulletin*). He stated further that the American Society of Civil Engineers should join the Federation and help solve the transportation problem; and also that the Federation "was not in a position to throw its total possible weight of influence into the great public tasks that are before it because of the failure of the civil engineers to co-operate."

In other words, Mr. Hoover suggested that unless the American Society of Civil Engineers should join the Federation, it would not be doing its duty to the country, and further that it was failing to co-operate. I trust I may be pardoned if I say that I do not think Mr. Hoover has any right to say or to imply that the civil engineers are any less desirous or capable of doing their duty to the country, or are not doing it, because they do not wish to do it in his way. When a man asks me to co-operate with him, I generally know what he means; he does not mean that he wishes to do what *I* want done, but that he wants me to help him to do what *he* wants done. This seems to be Mr. Hoover's idea of co-operation. For Mr. Hoover to suggest that the civil engineers do not do their duty to the country if they are not willing to subordinate themselves to the Federation, to put themselves in its power, and to let the Federation speak and act for them, perhaps by opinions or acts which the society as a whole might strenuously disapprove, does not conform to the ideas which I had formed of his fairness.

As a matter of fact, many of the members of the American Society of Civil Engineers, and myself among the number, have been doing what we consider our duty to the country for many more years that Mr. Hoover has. The writer has occupied somewhat prominent public positions for more than 25 years; and he has many times gone to Washington at his own expense to appear before committees of Congress, or to urge matters for the public

interest, such as the preservation of our forests, water power legislation, conservation, and the passage of the Jones-Reavis Bill for the reorganization of the Department of the Interior. Many other engineers have been doing public work of this kind while Mr. Hoover was still in foreign parts; and I do not think we can be blamed if we somewhat resent the implication that if we believe the American Society of Civil Engineers should preserve its independence, we are not doing our share of public service.

President Loweth had told the members assembled at his luncheon that if the American Society of Civil Engineers should not join the Federation, it would still be willing to co-operate with it, as it has already expressed its willingness to do. It will do this, I am sure, at any time that the government or that Mr. Hoover desires. It will appoint a committee to consider any public question which Mr. Hoover, or any other member of the cabinet, deems of public importance and desires to have it consider. Thus far, however, it has not been willing to abdicate or to allow any Federation or any other society in which it has only a minority interest to speak or act for it.

If Mr. Hoover wants the co-operation of the American Society of Civil Engineers, all he has to do is to ask for it. It will be given freely and fully, as President Loweth assured him. It is not at all certain that the American Society of Civil Engineers cannot do better public service out of the Federation than in it. At any rate, the society must be allowed to choose, and it should not be subject to criticism if it decides not to join. Mr. Hoover also assumes to designate as secondary any questions or arguments against joining the Federation. Should he not leave it to the society itself to judge what questions it considers secondary? GEORGE F. SWAIN.

Cambridge, Mass., Mar. 3, 1923.

Experiments with Cast-Iron and Steel Pipe

Sir—Mr. Tracy's letter on cast-iron and steel pipe at Ogden, Utah, in your issue of Jan. 25, p. 177, demands comment. The statement attributed to the mayor of Ogden that cast-iron pipe was being installed as an experiment was undoubtedly made in all sincerity but the history of cast-iron and steel pipe in Ogden, Salt Lake City and other places where alkali conditions are bad, makes further experiment with these two materials unnecessary. Cast-iron pipe laid in City Creek Canyon, Salt Lake City, in 1875 was dug up in 1919 and relaid in Sunnyside Ave. of that city. After its forty-four years of service, this pipe was found to be in first-class condition. In other parts of the system, where steel pipe was used, replacements have been made because of the failure of the pipe, until the entire distribution system of Salt Lake City now consists of cast-iron pipe. The gas company in Salt Lake City has had a similar experienece. In 1909 when the old gas plant was taken over by the new company, practically all of the steel pipe in the distribution system was replaced with cast-iron. At this same time, the smaller sizes of cast-iron that were laid in 1873 and 1874 were taken up and relaid in the city of Ogden, to replace steel gas mains that were losing 40 per cent of the gas delivered to them.

At Green River and Rawlins, Wyo., cast-iron lines have been in service fifty years, while steel pipe has been replaced at Spring Valley, Laramie, Ranchester, and Buffalo, Wyo. In fact practically every water-works in Wyoming that has ever used anything but cast-iron pipe has been forced to replace the inferior material.

Mr. Tracy admits that there are places where steel pipe has been replaced by the Ogden water department but he says that there are some places where steel pipe has given good service and a long life is to be expected.

Mr. Tracy further states that the difference in cost of cast-iron and steel pipe if placed at interest would make it possible to replace the steel line at the end of twenty-three years. The replacement of pipe involves factors other than the cost of pipe and laying. Tearing up streets; inconvenience to consumers; loss of large amounts of water through leaks previous to replacement; danger of failure of mains during fires; and high maintenance costs for several years previous to the final replacement. There is every reason to believe that one installation of cast-iron pipe will outlast several of steel pipe, and save these costs.

With such a great mileage of cast-iron pipe in the United States and such a small amount of steel pipe in service, one hears of more grief from cast-iron than from steel pipe. One of the larger pipe companies has carried on an investigation of all of the breaks that come to its attention and has found that in the great majority of cases they are due to some outside influence.

The real reason for the use of steel pipe in certain parts of the West in the past has been high freight rates. These have made the cost of cast-iron pipe so high that many towns could not be convinced that it was well worth its extra cost. The fact that many water-works have replaced their steel pipe with cast-iron shows that after having had experience with steel pipes they recognized that the difference in the first cost is represented in the greater worth of cast-iron pipe. THOMAS F. WOLFE,

Chicago, Feb. 7, 1923. Secretary The Cast Iron Pipe Publicity Bureau.

Proposed British Motor-Car Gasoline Tax

Sir—All vehicle taxation, whether horse, mechanical or gasoline, in Great Britain is levied and collected by the central government, that is to say it is what you would call a federal tax, as an annual tax the net proceeds from which are allocated to the improvement and maintenance of the "main" roads of the country. The actual expenditure of the money is, in general, carried out by the particular local authority responsible for the roads in any area. Thus the Lancashire County Council is responsible for the roads in that county; for those which have been designated as "main" roads a contribution is received from the proceeds of the vehicle tax and the remaining expenditure on "main" roads as well as that on the other roads in the county of Lancashire is covered from the Lancashire county taxes.

Some years ago it was agreed between the central government and the gasoline vehicle users that the annual taxation to be paid by the latter should be about $50,000,000 to $55,000,000 per annum. The tax is now levied on all motor cycles, cars, taxis and trucks on a basis of horse power of the vehicle and amounts to about $5 per horse power per annum.

The motor manufacturers and users associations are now pressing for the abolition of the horse-power tax and the substitution therefor of a tax of 10c. per gallon on gasoline with an additional purely nominal fee for the registration of each vehicle. This change they claim will not reduce the gross amount received and will be much fairer in its incidence than the present tax.

A tax of 10c. per gallon, or rather 8c. per American gallon, probably sounds pretty big to you—I think I have seen 2c. per gallon mentioned in *Engineering News-Record* as being the tax in Connecticut—but as compared with the States the ownership of a car is a luxury in England.

Common labor in New York earns $4 per day and the corresponding rate in London is ten shillings or $2.50 (8 hour day. $1 = 4 shillings). The cheapest British car costs £200 as compared with a figure in the States of $600. From these figures it follows that a cheap car in America represents 150 days work whereas in England it represents 400 days work of the same class of labor. It is quite wrong in such a case to make the comparison using rate of exchange, as even before 1914 the purchasing power of $1 in America was not the same as four shillings in England.

It is by reason of this high cost of cars in England that motor cycles, with or without side-cars, are so numerous in proportion to the cars. I think that in Great Britain there are about 500,000 private cars and 350,000 motor cycles, which is a much greater proportion than is the case with you. A cheap motor cycle and side-car costs about £80 ($400) in England.

London, England.

Feb. 4, 1923. F. J. RICHMOND,
Sir John Jackson, Ltd.

Low Bidding on Highway Work

Sir—Referring to a letter to the editor from Rodman Wiley, *Engineering News-Record*, Feb. 15, 1923, p. 317, the problem of contracts awarded at a sum below cost has reached the point where public welfare calls for a solution. I do not believe, however, that the solution lies in the direction pointed out.

If the low bid were of actual benefit to the public, it would not be a condition that should be changed, no matter what effect it has on the contractor as an individual or on contracting as a business. But we are beginning to realize that letting contracts below cost does not give the public the best that can be had for the money expended.

Generally speaking, the bid below cost is made by the incompetent bidder. There are different reasons why this lowest bid may not be to the best interests of the public. For example, the bidder may not have experience. If one hired a blacksmith to do the interior decoration of a court house, the taxpayer would not get the worth of his money, no matter how little it cost, nor how many efficient inspectors might be on the job. The losses from accidents and non-completion of contract for lack of funds, are added directly to the insurance and bonding rates to be paid eventually by the taxpayer. Loss due to work dragging, poor construction and interference with other operations, are further charges the public must make against the contractor who bids too low.

Since the evil of contracting below cost is a public affair, it is the public through their agent, the engineer or the architect, whose duty it is to make the correction. This is not a problem that the public should turn over to the contractor to solve, even if it is within the power of the contractor to solve.

The letting of construction work by contract has probably reached its highest development in railroad work. Can we not take a lesson from the railroad methods, which are, in short, to invite all contractors who are appropriate bidders for the work under consideration, and then let the contract to the lowest bidder. The lessons we must take from this are: First, the appropriate bidders, as a class, must be segregated from the inappropriate bidders; second, to save confusion in the owner's organization this must be done before the bids are opened, and preferably before they are submitted. This is not so easily done in public work as it is in private work, but still it is not impossible. The certified check has, in the past, been considered sufficient for this purpose, but has proven inadequate. Some engineers have required statements of experience, equipment and finances to be submitted with the proposal. This has kept some inappropriate contractors from bidding. It could be made more effective if a letter from the banker was required stating how much money or credit the contractor had for the work in question.

To avoid this difficulty a practical and effective method would be to require each prospective bidder to submit, a certain number of days before the letting, a statement of experience; the amount of credit obtainable; the amount of credit already employed on other work; a plan of operations; the name and experience of the superintendent; a list of tools which he obligates himself to put on the work, and other data as the peculiarities of the work in question require. The owner and his engineer could go over these statements some days before the letting and notify the prospective bidder whether or not his proposal is requested. This can be done without reflecting on the competency, as a contractor, of the proposed bidder. He may have his money, his superintendents, or his equipment, tied up on some other work, making him an inappropriate bidder at the time, although competent. By not making public the list of those competent to bid, the owner may receive all the advantages of competition, and at the same time be assured of letting the contract to an appropriate bidder, at such a price that the public may get the most for its investment.

Topeka, Kan., Feb. 26, 1923. LLOYD B. SMITH,
President, Topeka Bridge & Construction Co.

Highways and Light Railways in Argentina

Sir—The 24-in. gage agricultural lines built by the Buenos Aires Great Southern Ry. in the Argentine, as described in *Engineering News-Record* of Feb. 15, p. 307, are interesting examples of methods of bringing the produce of an agricultural district to the main railway lines in localities where road building materials are scarce, or as in this case entirely unavailable except by long haulage. Throughout much of the territory within a radius of 400 or 500 miles from Buenos Aires, and for much greater distances toward the northwest, the soil is first cousin to our western gumbo and there is not a sign of stone or gravel anywhere.

This method of solving the transport problem by the construction of light railways is proper for the railroad company, whose chief concern is serving its public to the extent of facilitating in every way the handling of its tributary traffic. But it is not one which seems to be the most advantageous in the long run for the development of the territory as a whole.

The ultimate solution of this problem is the construction of roads, and there is little doubt that if this were properly and rationally studied, a scheme could be worked out for the establishment of a system of passable highways, which would do a great deal to help the further intensive development of this most fertile section. It is true that road building materials are scarce—that is to say expensive by reason of the long hauls required, and that construction costs are high owing to the fact that the foundations are the black sticky gumbo-like soil. Still the application of our present day knowledge of the treatment of such soils would probably permit a solution within the limits of financial possibilities. In fact, at least one such scheme has been partially worked out and there is little doubt that but for the war, substantial progress would already have been made to develop a system of highways in the Argentine. At the present time it is almost correct to say that except in a very few instances highways usable the year round do not exist in the Argentine and motor cars cannot be used outside of a few of the larger cities and towns.

Coming back to the 24-in. gage railways, it may be interesting to note that one of these little railways has been in existence for many years, running easterly from the city of Corrientes in the northwest corner of the province of that name, to General Paz and San Luis, carrying both passengers and freight. It is now also seriously proposed to cover the two provinces of Entre Rios and Corrientes with a network of similar lines. In these two provinces between the river Parana and Uruguay there is much more easily available material for road building and it would seem that a system of highways might serve more people. The Argentine Government is also proposing to develop northern Patagonia (Rio Negro and Chubut by a system of 24-in. gage railways several hundred miles in extent, and I think construction on some of these lines has already been started.

South America is rather prone to try experiments in gages. The Argentine has had 5 ft. 6 in., 4 ft. 8½ in. and meter gage lines for many years, and it seems rather unfortunate at this late date to start the development of a fourth system, in spite of the fact that much may be said in favor of the particular experiment referred to in your article. Nothing said herein is in any sense a criticism of these feeders built by the Southern Ry. From its point of view the experiments seem to be entirely justified, but it would be regrettable if work of this kind should delay the construction of the highways the Argentine so greatly needs, or should lead to doubtful experiments in long-distant transportation by lines of this small gage.

In connection with the question of gage, which is a matter in which I have been much interested for several years, it is to be noted that in spite of the fact that the two great railroads in Peru (which start from the coast and cross the western range of the Andes at 15,000 to 16,000 ft. above sea level) are of standard gage (4 ft. 8½ in.), it is proposed to connect them by a meter-gage line. It seems to be difficult to make people realize that a light railway can be built with a wide gage.

New York City, FRED LAVIS,
Feb. 28, 1923. Consulting Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The preliminary permit granted James B. Girand for his Diamond Creek project on the Colorado River was entended six months from March 19. Mr. Girand's application for license is being held up pending ratification of the Colorado River Compact.

To avoid any duplication of work, a co-operative arrangement has been completed between the Bureau of Mines and the Bureau of Standards for the handling of studies being made of corrosion. The work is confined mainly to the corrosion problem as it affects metals and alloys exposed to mine waters.

The joint hearing of the New York Port Authority and the Interstate Commerce Commission over the possibility of putting into effect the comprehensive plan for the development of the port has been postponed from March 15 to April 5. Postponement was made necessary through the illness of Chairman Aitchison of Division 5 of the Interstate Commerce Commission.

By a majority of 1,883 votes the commission plan of government was adopted by Camden, N. J., on March 6. At an election to be held about the middle of April five commissioners will be chosen in place of the mayor and 28 councilmen under the present plan. The change was favored by Victor King, the present Mayor of Camden. Most of the cities of New Jersey are already under the commission plan.

French reconstruction work in Alsace and Lorraine to date includes the restoration of 79 per cent of the acreage of agricultural land devastated during the war and about 67 per cent of the number of factories destroyed. About 44 per cent of the number of houses damaged or destroyed have been repaired or reconstructed and more than 1,000,000,000 francs have been spent in the work of restoration, says a recent bulletin issued by the Bankers Trust Co. of New York.

A bill to abolish the engineers license law in Colorado has been withdrawn. The Colorado Society of Engineers which sponsored the act now on the statute books reports that opposition to the law came from mining engineers. The later group seem to have been convinced when it was pointed out that the law would have a salutary effect in checking the unscrupulous man (not qualified) who would make any sort of mining report desired. License fees from the engineers are going into a library for engineers, an arrangement about which the society is enthusiastic.

Tax Exemption of New Dwellings in New Jersey Illegal

The New Jersey law of 1920 exempting from taxation for five years new buildings erected for residence purposes has been declared unconstitutional by the New Jersey Court of Errors and Appeals, thus affirming a similar decision of the Supreme Court handed down about a year ago. Both courts hold that the act is unconstitutional because it creates an arbitrary classification of property. Soon after the law was passed the attorney general of the state ruled that it was unconstitutional and it is reported that many, if not most, of the municipalities of the state have continued to levy taxes against new buildings for residence purposes.

Contractors Ask Federation to Consider Rising Costs

The Associated General Contractors of America some time ago addressed to the Federated American Engineering Societies a letter asking the Federation to appoint an engineering committee to set in motion a nation-wide co-operation movement to combat the rising costs of construction. In response to this appeal the committee on procedure of the Federation adopted resolutions stating that it views with approval the proposed co-operation and authorizing President Cooley to appoint a committee to co-operate with some authoritative agency, such as the American Construction Council or the Associated General Contractors, to consider the problem.

The A.G.C. letter states that "The seasonal demand of construction for labor, materials and transportation which reaches its peak in late summer coincident with the seasonal peak of many other industries, has created a shortage of all of these items each year. This shortage occurring at the peak of the construction season, appears to be growing more acute and the difficulties thereby involved more troublesome each year. In the construction field we believe that the only effective remedy for the situation lies in lengthening the construction season as much as possible, and in performing all work possible during the winter season. This procedure will produce more continuous production of materials in the basic industries and should also enable us to suppress during late summer the peak of the transportation demand." As to climbing costs, the contractors added: "We believe that the construction industry will be seriously damaged unless this trend is stopped and the public be informed thereof, and therefore we ask that you join with us in doing all things possible to publish this with a view of stabilizing the construction industry and keeping it going at a normal rate and to take out of it its cyclical periods."

A report on the question will be made by President Cooley at a meeting of the executive board of the Federation, March 23-24.

Clyde Potts Denies Direct Oxidation Co. Charges

Alleges Attempt to Browbeat State Board and Asks Governor to Investigate Activities of Company

The charges (*Engineering News-Record*, March 8, p. 462) brought by the Direct Oxidation Disposal Corporation against the New Jersey State Board of Health in general and Clyde Potts in particular alleging unreasonable delay, with improper motives on the part of Mr. Potts, in acting upon plans for sewage-works for Trenton, N. J., drawn by Col. George A. Johnson, have been denied by Mr. Potts in a letter to Governor Silzer, as follows:

30 Church St., New York City,
March 12, 1923.

"Honorable George S. Silzer,
Governor,
Trenton, N. J.

"Sir—On Feb. 19 certain charges were made by H. Jerome Hirst against me, specifically, and against the other members of the [State] Department of Health for delay in approving the plans for sewage disposal works for the City of Trenton. These charges were referred by you to the Department of Health, and at the last meeting of the Department of Health [March 6] they were returned to you because of the impropriety of the department examining charges made against one of its members or the members of the board collectively.

"I will be glad to appear before you any time and give you any information concerning this company which you desire.

"Their charges against me personally, are, of course, untrue, as are also the charges against the other members of the board as to their being influenced in this matter. This letter to you and the propaganda which this company is putting out in the newspapers is merely an effort to browbeat and blackguard the State Department of Health into an attitude where it will approve these Trenton plans without a proper investigation.

"As you may know, the State Department of Health approved this system for the Town of Phillipsburg with the understanding that it was to be an experimental plant. So far as the Department of Health is concerned it is still an experimental plant as it has not yet been accepted by the department. It was built two years ago and the irregularities connected with this erection were so serious that Judge Gnichtel was appointed a Supreme Court Commissioner to investigate the Town of Phillipsburg and the proceedings in connection with the erection of this plant. As a result of that investigation the Grand Jury indicted the Municipal Disposal Corporation of Philadelphia as a corporation, and this man H. Jerome Hirst as an individual, for irregularities in connection with the erection of the plant there, and the matter has not yet been brought to trial.

"Under the circumstances surrounding the erection of the Phillipsburg plant and the fact that this system is still in the experimental stage it is strange that there should be such a great demand for speed in connection with the Trenton plans.

"I would therefore suggest to you that in investigating the charges made by H. Jerome Hirst, that you broaden out the scope of the investigation so as to include the activities of the Direct Oxidation Corporation and H. Jerome Hirst, not only in the State of New Jersey but in other states, which will be brought to your attention, as well.

"The filing of these charges and the subsequent acts of these parties shows, I believe, an effort to dominate sewage disposal matters in the State of New Jersey by a patented sewage disposal combine, that is well worth your best efforts in detecting in its incipiency.

Yours respectfully,
Clyde Potts."

At a meeting of the City Commission of Trenton on March 9, Mayo Donnolly, a member of the commission, offered a resolution asking the State Board of Health to postpone the date on which it must have sewage-works in operation on the grounds that the city cannot finance sewage-works without sacrificing its school building program; that the direct-oxidation process is still in an experimental stage; and that already $30,000 has been expended in reconstructing the direct-oxidation plant at Phillipsburg, N. J. The other four members of the commission voted against the resolution and declared themselves in favor of asking Governor Silzer to investigate the charges filed against the State Board of Health.

N. J. Highway Body Confirmed

The eight-weeks battle for control of the New Jersey Highway Commission was terminated on March 13 by the confirmation of the four nominees by the Senate. The new board is now made up of General Hugh L. Scott, of Princeton, and Walter Kidde, Montclair, Republicans, and Abraham Jelin, of New Brunswick, and Percy Stewart, of Plainfield, Democrats. The vote in the Senate was 12 to 7, some of the Senators voting one or two members only.

Tri-State Delaware Water-Supply Again Advocated

Negotiations for a tri-state treaty between New York, New Jersey and Pennsylvania, looking to the joint development of the Delaware River for public water-supply purposes, hydro-electric power and flood prevention, similar to the port authority treaty between New York and New Jersey, is advocated by George J. Gillespie, president of the Board of Water Supply of New York City, in a letter to Alfred E. Smith, Governor of New York.

Mr. Gillespie proposes that the New York Legislature authorize Governor Smith to appoint a commission to cooperate with like commissions representing New Jersey and Pennsylvania for the purpose already stated. This general plan was proposed recently by Morris R. Sherrerd, chief engineer of the North Jersey District Water Commission, and a bill to that end was immediately introduced in the New Jersey Legislature.

Stewart Company Wins Point in War Fraud Suit

Judge Jacob Trieber, sitting in federal court at Little Rock, Ark., has sustained a motion of counsel for the Stewart Construction Co., of New York, to compel the government to file a bill of particulars in its suit charging fraud in connection with the building of Camp Pike. The Stewart company is charged with defrauding the government of $3,000,000 in connection with the construction of the camp. The suit against the Stewart company was filed Dec. 4, 1922.

Boston Sanitary Engineers Addressed by M. N. Baker

The annual meeting of the Sanitary Section of the Boston Society of Civil Engineers was held on March 7, just before the dinner of the Affiliated Technical Societies of Boston. John P. Wentworth was elected as chairman of the section for the ensuing year and H. P. Eddy, Jr., was re-elected as clerk. There are now about 190 members of the section. The average attendance at the meetings during the past year was about thirty. After the business session M. N. Baker, associate editor of *Engineering News-Record*, spoke on "Engineering and Public Health." An abstract of the address appears elsewhere in this issue.

Joint Meeting on Hydro-Electric Power for New York

On March 21 at the Engineering Building Societies' Building, New York City, there will be held a joint meeting of the New York sections of the four national engineering societies to discuss the problem of hydro-electric power for the New York City metropolitan district. The program includes the following:

PART I. A CO-ORDINATED SYMPOSIUM

F. W. Scheidenhelm, consulting engineer (Mead and Scheidenhelm), New York: Co-ordinating Statement of the Problem.

W. S. Murray, consulting engineer (Murray & Flood, Engineers), New York, formerly Chairman, Superpower Survey, U. S. Government: An Approximation of Available Water Power and Cost of Delivery.

George A. Orrok, consulting engineer, New York Edison Co. and affiliated companies: Requirements of Service and Evaluation of Hydro Power.

F. A. Allner, general superintendent, Pennsylvania Water & Power Co., Baltimore (in charge of 100,000 kw. Holtwood plant on Susquehanna River): Quality of Hydro Service.

Lorin E. Imlay, consulting engineer, Niagara Falls Power Co.: Reliability of Long Distance Transmission.

PART II. DISCUSSION

John P. Hogan, consulting engineer with William Barclay Parsons, New York: W. S. Finlay, Jr., New York, vice-president, American Water Works & Electric Co., formerly Superintendent of Motive Power, Interborough Rapid Transit Co.; discussion from the floor.

Arizona and Colorado Fail to Ratify Colorado Pact

Five of the seven states signatory to the so-called Colorado River Pact ratified that pact by acts of their legislatures just adjourned, but Arizona and Colorado failed to do so. Consequently the federal Congress did not ratify and the joint control of the river must go over for another year. In Arizona the treaty became a part of a local political fight started and continued on other issues. For a time it looked as though the pact would be ratified but the final vote was 27 to 22 and the treaty was therefore rejected. Colorado had apparently been waiting to see which way Arizona voted and did not act. Wyoming, Utah, California, Nevada and New Mexico ratified.

Provisions of the compact are explained in an article which appeared in *Engineering News-Record* Dec. 7, 1922, p. 987.

Ketchum Inducted as Engineering Dean at Illinois

Milo S. Ketchum, formerly dean of the College of Engineering at the University of Colorado and later professor of civil engineering at the University of Pennsylvania, was formally inducted as dean of the College of Engineering of the University of Illinois and Director of the Engineering Experiment Station at a University Convocation at Urbana, March 7. The new dean, who is a graduate of the University of Illinois, was inducted into office by the president of the university, Dr. David Kinley, and was welcomed by W. L. Abbott, on behalf of the Board of Trustees, and by Prof. A. N. Talbot, on behalf of the faculty. The principal address, on "The Importance of Research to Industrial Progress" was delivered by E. J. Mehren, editor of *Engineering News-Record*. In responding to the formal address of induction, Dean Ketchum discussed fundamentals in engineering education and the place of research in the education of the engineer. Extracts from the addresses will appear in an early issue.

Razing High Bridge Authorized by New York Board of Estimate

Removal of High Bridge over the Harlem River, a part of the first Croton Aqueduct built by New York City some eighty years ago, has been authorized by the Board of Estimate and Apportionment. The Department of Water Supply, Gas and Electricity has been directed to prepare plans for conveying beneath the river the water carried by pipes on the bridge, and the Department of Plants and Structures has been directed to prepare plans for razing the bridge. This action follows several years of agitation for either the destruction of the bridge or else the removal of some of its piers for the improvement of navigation in the Harlem River. The old Croton Aqueduct has been held in reserve since the Catskill Aqueduct was put in use in 1917 but recently it has been under inspection in view of possible restoration to service in case the Catskill supply should become inadequate before the supplementary supply from Schoharie Creek is available.

Railroad Problems Theme at Boston Engineers' Dinner

The first annual dinner of the Affiliated Technical Societies of Boston and the fourteenth annual dinner of Boston engineers was held at the Copley Plaza Hotel, March 7. Leonard Metcalf, chairman of the Affiliated Technical Societies of Boston, acted as toastmaster. The speakers of the evening were Dr. Samuel W. Stratton, the new president of the Massachusetts Institute of Technology, Edward E. Whiting, of the Boston *Herald*, and Charles A. Andrews, former president of the Associated Industries of Massachusetts.

Dr. Stratton questioned whether the engineering schools are covering the fundamentals and, after urging the importance of research work, laid stress upon the importance of having it correlated with the practical every-day problems of the engineer.

Mr. Andrews spoke on "The Why and How of Railroad Consolidation," reviewing the subject in general and at the close dealing particularly with consolidations in the New England territory, the whole referring to the requirements of the Transportation Act of 1920. Mr. Andrews urged that instead of making the New England railroads a group by themselves, as it appears some New England people are strongly urging, some such plan should be adopted as combining the New York, New Haven & Hartford with the Pennsylvania and putting the other railroads of New England with either the New York Central or the Delaware & Hudson.

Engineering Standards Committee Adds Sustaining Members

Change of the organization of the American Engineering Standards Committee by the addition of "sustaining members" with a view to developing industrial standardization has been announced by the committee. In this class of membership, dues are fixed on the basis of 1c. per $1,000 of gross receipts of the industry concerned. Twenty industrial executives have been named as an advisory committee in connection with the proposed industrial standardization work.

Heretofore the American Engineering Standards Committee has done its work with funds consisting only of dues paid by nine technical societies and seventeen trade associations, which together with seven departments of the federal government, formed its membership. Deficits were incurred in the operation of the committee, and these were covered by contributions obtained from various corporations. The financing of industrial standardization is expected to provide $50,000 annually.

A. W. Whitney, chairman of the American Engineering Standards Committee, states that industrial standardization may be expected to produce economies "measured in billions of dollars, not millions." So far as plans announced up the present show, the only service now contemplated in addition to that carried on by the committee hitherto is the issuing of information bulletins on developments in standardization work in the United States and other countries.

Federal Government Defends Water Power Act

In answer to the bill of complaint entered by the State of New York in the U. S. Supreme Court to test the authority of the Federal Water Power Act, Solicitor General Beck has set up the claim that the federal government has authority over the barge canal system of New York under the interstate commerce clause of the constitution, a canal system being a part of an interstate and foreign commerce waterway.

In its amended bill, the state claims that it has spent great sums on the development of waterways within the state and has projected hydro-electric developments concerning which it claims the Federal Power Commission had no authority. The government, in its answer, declares the bill does not join essential parties in that no determination can be made of the authority of the United States to enter into contracts with citizens of New York for the acquisition of real or other property useful in the preservation or improvement of navigation in the absence of the citizens whose property is affected. The government further claims that the state does not present any concrete plan regarding its proposal for hydro-electric development or how much plans would affect navigation.

Regarding the state's announced contemplation of hydro-electric development on the St. Lawrence River, the government sets forth that this waterway has been the subject of an international conference by act of Congress looking toward its improvement for oceangoing transportation and that if the state were to make any effort to construct plants there the Federal Power Commission would seek action by the attorney general to determine the effect. The Federal Power Commission, it is pointed out, does not construct plants, and such construction by those licensed to do so by the Commission would not deprive the state from the rights of taxation of such properties.

Boston Technical Societies Study Railroad Consolidation

A special committee of the Affiliated Technical Societies of Boston has submitted majority and minority reports as to the policy that should be followed with regard to the New England railroads under the consolidation provision of the transportation act.

The majority report, which is signed by George F. Swain, chairman, Charles T. Main, Charles R. Gow, Dugald C. Jackson and Leonard Metcalf, recommends that the New Haven R.R. should be consolidated with one of the trunk lines and that the other independent New England lines be consolidated with another of the trunk lines. Although the committee does not state which trunk lines the New England lines should consolidate with, they suggest that the New Haven should go with the Pennsylvania and the northern New England lines with the New York Central or the Delaware & Hudson.

In a minority report, E. C. Hultman, expresses the opinion that the sound solution of the New England transportation problem is a New England consolidated system which would embrace all the railroad lines in New England.

Proposed Bill Enables Ohio Cities to Charge for Sewer Use

A bill designed to provide funds for the proper maintenance and operation of sewerage systems and sewage-works has been drawn by the Ohio Department of Health and introduced in the State Legislature (Senate Bill 93). The proposed legislation is permissive, not mandatory.

The bill authorizes the legislative body of any city or village in Ohio to pass an ordinance establishing "just and equitable rates or charges" for the use of sewerage systems, the charges to be a lien upon the property connected with the sewer. The management of sewerage systems and sewage-works would be in charge of the director of public service in cities while in villages it would be under the board of trustees of public affairs, the director, and the board, respectively, to have the authority to appoint proper officers to take immediate charge of the sewers and sewage-works. The bill also authorizes the director of public service in cities and the board of trustees in villages to make necessary by-laws and regulations for the operation and protection of sewerage systems and sewage-works and for the construction and use of house sewer connections.

All money collected for the use of sewerage systems would be kept in a distinct fund used only to pay operation and maintenance charges of the sewerage system or sewage-works, together with any enlargement or replacement of the same; also in payment of interest on any sewer debts and for the creation of a sinking fund. The sewer fund could not be drawn upon the extension of the sewerage system into unsewered areas or for any other purpose except those named.

Bids Received for Large Addition to Baltimore Water Filters

Bids for the excavation and concrete for a 113-m.g.d. mechanical filtration plant contiguous to the present 128-m.g.d. plant of the Baltimore waterworks at Montebello, were received by the City of Baltimore, Md., March 7. The new plant will be similar to the existing one except for changes shown by operation to be desirable. The bids cover a mixing basin, coagulating basins, filters, head house and filtered water reservoir. The passages, head house, etc., are designed to serve a plant with a total capacity of 165 m.g.d. The superstructure will be let separately later on, except that the bids just received include concrete columns and roof beams above ground.

There were six Baltimore and one New York City bid. The totals of the two lowest and the highest bids were: (1) Carroza-Rowe Construction Co., Baltimore, $1,248,955; (2) Consolidated Engineering Co., Baltimore, $1,310,194; (3) Frederick Snare Corporation, New York City, $2,083,040.

The unit bids on some of the most important items were: Excavation, (a) $0.65; (b) $0.74; (c) $1.30 per cu.yd. Concrete, Class B, (a) $18.30; (b) $19.50; (c) $33 per cu.yd. Reinforcing steel, (a) 5c.; (b) and (c) each 5½c. per pound.

William A. Megraw is water engineer and James W. Armstrong is filtration engineer of Baltimore.

Rigid Rules Attend Award of High Dam to Ford

Must Apply for License by July 1, And Show Contracts for Sale of All Available Power

Washington Correspondence

In awarding a preliminary permit to Henry Ford covering the High Dam project in Minnesota what very apparently is a concession to public opinion in the locality was made by the Federal Power Commission. So as to guard against such non-use as has followed the construction of the Ford dam at Troy, N. Y., and to safeguard the public interest in other ways, the commission imposed very strict conditions in extending the preliminary permit.

In the first place, provision is made to insure the maximum possible utilization of the power. Mr. Ford is required to install four units with the maximum capacity of 4,800 hp.

Mr. Ford is required by the permit to apply for license before July 1. On that date he must present executed contracts for the sale, delivery and use of the maximum power that can be delivered at the dam. This probably means that a large block of the power must be sold to the Northern States Power Co. That company is understood to be ready to purchase such power as Mr. Ford has to sell but since it is now securing dump power for two and one-half mills per kilowatt-hour, delivered, it was brought out clearly at the hearing that the company would not be willing to pay a higher rate to Mr. Ford. It could be discerned that the Northern States Power Co. has some apprehension as to what might develop if one or both of the municipalities, adjacent to the High Dam, should be given power for general use.

Chief Engineer Mayo, of the Ford staff, who appeared in his behalf, told the commission that it is the expectation to use the power principally in electric furnaces. No attempt was made to explain why Mr. Ford is desirous of resorting to hydro-electric power for his St. Paul plant when engineers' estimates are that it will cost three times as much as power he could develop from coal at such a plant.

A further condition imposed by the commission is an annual charge of $95,500 for the use of the government's dam. Mr. Ford is also required to put in a tail race 2,000 ft. long, so as to prevent the silting up of the navigation channel and the lock.

Provide $10,000,000 a Year for Mississippi Floods

Congress passed, and the President signed, on the last day of the last session, a bill authorizing the appropriation of $10,000,000 a year for a period of six years to be spent for "controlling the floods of the Mississippi River and continuing its improvement from the Head of the Passes to the mouth of the Ohio River" under the provisions of the Mississippi River flood protection act of 1917. By this earlier act local interests have to furnish funds up to 50 per cent of those furnished by the federal government.

The new allotment is to be expended under the direction of the Mississippi River Commission.

Staff Changes in Engineering News-Record

Willard Chevalier, who has been associate editor of *Engineering News-Record* for the past year, becomes on Mar. 15 business manager of this journal. Colonel Chevalier, previous to his connection with *Engineering News-Record*, was for seven years engaged in selling work as salesman and sales manager. He succeeds William Buxman, who was business manager of *Engineering News* at the time of the consolidation of that journal with *Engineering Record* and has been business manager of *Engineering News-Record* since that time. Mr. Buxman with the title of assistant to the vice-president, becomes assistant to E. J. Mehren, vice-president in charge of the engineering unit of the McGraw-Hill Co., Inc. This unit comprises *Chemical & Metallurgical Engineering, Coal Age, Engineering and Mining Journal-Press* and *Engineering News-Record.*

Congress Authorizes Over $70,000,000 for Highways

Washington Correspondence

In addition to the $65,000,000 which Congress authorized for federal aid during the fiscal year which will end June 30, 1924, $6,500,000 was authorized for highways in the eleven western states and in Alaska, where there are forest reservations. Due to the differences which arose between the two Houses over this last appropriation, the conference report on the agricultural appropriation bill was delayed until just before the adjournment of Congress.

he House voted $3,000,000 for forest roads. The Senate increased this to $6,500,000. The compromise which finally was reached provides that $3,000,000 is appropriated outright, with authorization to place the remaining $3,500,000 under contract. This means that the $3,500,000 will be carried in the first deficiency bill after the new Congress assembles.

Boston Engineers Request Speedy Trial of War-Fraud Charges

At the annual dinner of the Affiliated Technical Societies of Boston on Mar. 7, participated in by some 300 members of one or more of the nine engineering societies in Boston and vicinity, a resolution was adopted urging the prompt trial of the engineers and contractors formerly connected with the Construction Division of the United States Army who are now under indictment, or against whom civil suits have been instituted. The preamble recites that the 3,300 engineers composing the membership of the affiliated societies "were greatly surprised and shocked by the indictment of certain of" their associates and of "other engineers and contractors, and by the bringing of civil suits by the United States Government to recover millions of dollars for alleged frauds, especially in view of the nature of the specific charges." The resolution expresses the feeling "that justice demands a prompt trial so that the innocent may be freed of the serious accusations which have been made against them."

Arthur St. Laurent Dies

Arthur St. Laurent, chief engineer of the Department of Public Works of the Canadian Government, president of the Engineering Institute of Canada, a member of the American Society of Civil Engineers and the International Congress of Navigation, died in Ottawa last week, aged 65 years. Mr. St. Laurent was elected president of the Engineering Institute of Canada, January 22 of this year, at the annual meeting in Montreal.

Mr. St. Laurent was born in Rimouski, Province of Quebec, in 1859. He was graduated from Montreal University. In 1888 he entered the service of the Public Works Department of Canada at Ottawa as principal draftsman and as principal assistant on harbor surveys. In 1891 he was made assistant engineer in the Winnipeg office which was in charge of the departmental operations in northwestern Ontario, Manitoba, and the Northwest Territory. In 1898 he was transferred back to headquarters at Ottawa as principal assistant engineer in charge of designs and contract plans for a lock and dam at St. Andrews Rapids on the Red River. Other work over which he had supervision included a traffic bridge across the North Saskatchewan River at Edmonton, the lengthening of the dry dock at Levis, Quebec, and alterations to the dry dock at Kingston, Ont.

In 1902 he was in charge of the construction of the Laurier bridge at Ottawa and of grain elevator No. 1 at Montreal Harbor. During that period he was acting as assistant chief engineer and in charge of the chief engineer's office on several occasions.

It was Mr. St. Laurent who introduced concrete in bridge construction in western Canada during the construction of the Edmonton bridge. He proposed the use of concrete in this structure, the proposal occasioning many prophecies of dire disaster. The bridge piers reached their full height and when spring came with its ice-laden current, ordinary structures in the valley were swept away. The piers however, withstood the test and it is recalled that the old "Northcote," a steamboat of Northwest rebellion fame, was completely wrecked against one of them. After this experience the public attitude changed and the young engineer received the credit due him.

Settlers on Reclamation Projects Given Time for Payments

Extension of time for payments due from settlers on United States Reclamation projects is authorized, at the discretion of the Secretary of the Interior, under an act passed near the close of the recent session of Congress. According to a statement issued by the Secretary "three classes of relief will be given that include the extension of time of payment of construction charges on irrigation ditches due during or before 1922 to any date not beyond Dec. 31, 1924; the furnishing of irrigation water during the season of 1923 regardless of delinquencies in payment of past charges by the farmers either for operation or construction due the Government; and the future payment of accrued charges both for operation, maintenance, and construction unpaid in 1922 or previous to that year, over a period of time by installments."

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Meeting, New Orleans, La., April 18-20.

NATIONAL FIRE PROTECTION ASSOCIATION; Boston; Annual Meeting, Chicago, May 8-10.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Florida Engineering Society will hold its annual meeting at Jacksonville March 19 and 20. J. R. Benton, of Gainesville, is secretary of the society.

The New York Section of the Am. Soc. C. E. at its February meeting heard a paper by Albert A. Northrop, of Stone & Webster, on the Caribou Plant of the Great Western Power Co. in California.

Engineering Society of Wisconsin has elected the following as officers for 1923: President, John C. White, chief operating engineer of the power plant of the State Capitol; vice-president, W. G. Kirchoffer; secretary and treasurer, L. S. Smith, all of Madison, Wis.

The San Francisco Section, Am. Soc. C.E., on Feb. 20 held a regular bimonthly meeting at which the main topic of discussion was "Foundation Problems in the Filled-in Area of San Francisco." Speakers who presented prepared discussion on various phases of the topic were: A. A. Brown, J. M. Owens, Frank G. White, and C. Derleth, Jr.

The Texas Section American Society of Civil Engineers will hold its spring meeting in Ft. Worth April 13 and 14. Because of the general interest in Texas of water conservation and flood control the papers will be largely devoted to these subjects. The meeting will be in charge of A. J. McKensie, first vice-president, as the president, E. E. Sands, is seriously ill in Boston.

The Western Society of Engineers March 26 will hear an address on "Relief from Floods" by C. B. Burdick, of Alvord, Burdick & Howson, consulting engineers, Chicago. On March 13 a symposium on "Locomotive Terminals" was held.

The Triangle Club of New Jersey was organized at a meeting held in Jersey City last week. Architects, draftsmen, professional engineers, superintendents of construction, or others whose qualifications are satisfactory to the membership committee, are eligible to join. The purpose of the organization is the promotion of a general spirit of good fellowship. Officers elected were Hugh A. Kelly, president, Harry J. Oste, vice-president, and Peter J. Gannon, secretary.

Personal Notes

HARDGROVE NORRIS, has resigned from the Atlantic Coast Line to accept a position as assistant engineer in the maintenance-of-way department of the Florida East Coast Ry. Co.

J. R. TAFT, civil and railway engineer of New York City, has removed his office to Retsof, in Livingston County, New York, where he will continue his independent practice.

J. R. ARNOLD, former assistant supervisor, maintenance-of-way department of the Pittsburgh Railways Co., has become a partner in the general contracting firm of Pringle and Arnold, Washington, D. C. The firm will also act as sales agents of certain structural specialties.

SHELBY POST, until recently a resident engineer of the Hardaway Contracting Co., of Columbus, Ga., has been made a superintendent of construction for the Southeastern Construction Co., of Charlotte, N. C.

M. W. WATSON, state highway engineer of Kansas, has tendered his resignation to the governor and commission, effective April 1, 1923. His future plans have not yet been announced. Mr. Watson has been chief engineer of the Kansas Highway Commission since July, 1918. Prior to that time he served as road engineer of the Kansas commission, and in various engineering capacities with the state highway commission of Illinois. He is president of the Mississippi Valley Association of State Highway Officials.

E. J. CLEAVE, for the past three years superintendent of the Philadelphia division of the Pennsylvania R.R., has been transferred from Harrisburg to Philadelphia, where he will have a special duty in the general manager's office. Mr. Cleave entered the service of the Pennsylvania R.R. in 1881. He has held the position of assistant supervisor at various stations. He was also division engineer at Williamsport. In 1900 he was appointed assistant to the principal assistant engineer at Altoona, a few months later being made principal assistant engineer. Later he was promoted to be superintendent of the Cresson division, and in 1917 he was made superintendent of the Trenton division with headquarters at Trenton, N. J.

PROF. W. K. HATT, director of the Advisory Board on Highway Research of the National Research Council, will sail for Europe on Mar. 17. He will make a study of highway development in several countries there and will attend the International Road Congress, to be held in Seville in May. He will return to the United States early in June.

WALTER G. BLACK, of Mandan, N. D., has been appointed state engineer of North Dakota, and chief engineer of the state highway commission for a term of 4 years commencing April 1. Mr. Black is a member of the firm of Black and Griffin, consulting engineers, of Mandan. He has had extensive experience in the construction of highways. In the World War he served as a commissioned officer in the engineers, and in the reserves is in command of the 522nd Engineer Train (Heavy Bridge). He is a member of the American Society of Civil Engineers and the N. D. Society of Engineers, and is past-president of the N. D. Chapter of the American Association of Engineers.

H. E. SNOW has been appointed city engineer of Brownsville, Tex.

S. J. TREADAWAY has resigned as county engineer of Bell County to become district engineer of Terrell Road District at Terrell, Kaufman County Tex.

A. C. PANCOAST has been appointed county engineer of Bexar County at San Antonio, Tex.; and FRED M. PERCIVAL, recently engineer at Rison, Ark. will succeed Mr. Pancoast as engineer for San Patricio County at Rockport Tex.

GLENN L. ALT, an instructor in the University of Michigan engineering department, has secured a temporary leave of absence and is employed as a resident engineer for the Ann Arbor R.R. Co. He is stationed at Toledo, O.

HAMILTON F. GRONEN, former city commissioner of Tacoma, Wash., has been appointed to succeed William J. Roberts, as chief engineer of the intercounty river improvement work carried on under the joint supervision of the commissioners of King and Pierce Counties, Wash.

OSBORNE SAXTON, for many years past head of the engineering and contracting departments of the Whitney Co., and for many years previous thereto assistant chief engineer of the Snare & Triest Co., both of New York, has resigned from the Whitney Co. and has together with SUMNER GERARD formed the Saxton-Gerard Co., Inc., a firm which will engage in building construction.

N. B. AMBLER, J. T. BRUSKY, HARRISON E. KLEFFEL, and THOMAS RICHARDSON have recently joined McClellan & Junkersfeld, Inc., engineers and constructors, New York. Mr. Ambler for the last ten years has been superintendent of the Toronto Power Co., Ltd., Niagara Falls, Ont. Mr. Brusky was formerly with Stone & Webster, Inc., and the American International Shipbuilding Corp. Mr. Kleffel was with the Peabody Engineering Corp., New York City, and Mr. Richardson was with the M. W. Kellogg Co., New York City.

LESTER S. READY has been appointed chief engineer of the California State Railroad Commission to succeed RICHARD SACHSE who resigned to enter private practice as a consulting engineer. The appointment is effective March 1. The new chief engineer has been associated with the Railroad Commission more than nine years, having been assistant chief engineer, in charge of the Gas and Electric Department, four years. He is a native of Ventura County, and a graduate of the University of California. The commission has appointed A. V. GUILLOU as assistant chief engineer in charge of the Gas and Electrical Division of the Commission. Mr. Guillou, who is also a graduate of the University of California, has acted as assistant engineer in the Gas and Electric Division for the last three years.

FRED A. LORENTZ has been chosen by the Board of Public Utilities, of Los Angeles, as chief engineer of the board to succeed H. Z. OSBORNE, JR., who recently resigned, his resignation becoming effective March 1. Mr. Lorentz has been in the department for the past twelve years as engineer in charge of street railway transportation.

F. P. GUTELIUS has been appointed resident vice-president at Montreal for the Delaware & Hudson Ry. to succeed C. S. SIMS, who resigns to return to his profession as engineer. Mr. Gutelius is one of the best known railway men in Canada. He has had long service with the C.P.R., and was for many years general manager of the Canadian Government Rys.

Obituary

FRANK GRAVES, for more than 30 years a builder and contractor in Los Angeles, Calif., died in that city Feb. 26, aged 70 years.

ROBERT BAIN, aged 80, a resident of California for 40 years and a pioneer in the contracting and construction field in Los Angeles, died in that city Feb. 26.

P. H. WILSON, vice-president of the J. G. Wilson Corporation, died in Rochester February 11 after an illness of two years. Mr. Wilson has been general manager of the Wilson corporation for five years prior to his election as vice-president.

CAPT. R. B. RICE, president of the Rice Construction Co., of Portland, Ore., died recently, aged 63 years. He was formerly connected with the Crosby Transportation Co., of Muskegon, Mich., but for the past 20 years has been in the contracting business in Portland.

JOHN R. HANSEN, assistant to the city engineer of Portland, Ore., died recently in Chicago, where he had undergone an operation. He was seventy years of age. Mr. Hansen, a native of Norway, had been in the employ of the engineering department of Portland since 1891.

WILLIAM DEFOREST STRATTON, for many years president of the Mobile, Jackson & Kansas City R.R., and also a railroad contractor, died at his home in Middletown, N. Y., last week. Mr. Stratton was 78 years of age. He built a number of important railroad bridges, among them being the Pennsylvania R.R. bridge across the Susquehanna River at Harrisburg, a bridge across the Delaware at North Philadelphia and one across the Mississippi at Ruolo, Neb., for the Illinois Central. He also was in charge of constructing the Baltimore & Ohio tunnel through Philadelphia.

FRANKLIN COGSWELL PRINDLE, a retired rear-admiral in the Civil Engineer Corps of the United States Navy, died at the Naval Hospital, Washington, D. C., March 6, aged 82 years. Admiral Prindle was born in Vermont and received his early education in Arlington, later becoming a student at Rensselaer Polytechnic Institute. However, he was not graduated inasmuch as the Civil War broke out shortly after he entered college and he enlisted in the Engineering Corps of the Navy, subsequently winning an appointment as third assistant engineer. After two years' service at sea he was promoted and returned to a post in New York City. At the end of the war he resigned, but two years later accepted an appointment as assistant civil engineer at the New York Navy Yard. He was commissioned a civil engineer in the Navy in 1869, winning successive promotions until at the time of his retirement in 1890 he was a captain. During his active professional career he served as civil engineer at the navy yards in stations at Portsmouth, N. H., Boston, Newport, Brooklyn, League Island, Norfolk, Port Royal, S. C., Key West and Pensacola, Fla., Mare Island, Puget Sound, Yerba Buena Island, Calif., and Honolulu. In addition to his military career, he served various large corporations in an official capacity. He was elected a member of the American Society of Civil Engineers in 1874 and of the Institution of Civil Engineers of Great Britain in 1883.

WILLIAM A. HOWELL, engineer of streets and highways of the City of Newark, N. J., and former president of the American Society for Municipal Improvements, died at his home in Newark, March 12, aged 63 years. He had been in the employ of the city since 1893. Mr. Howell was a graduate of New York University. His first engineering experience was with the Pennsylvania R.R., serving that road in various engineering capacities for 10 years, when, in 1889 he was made chief engineer of the New York, Susquehanna & Western R.R. The following year he engaged in railroad engineering in the West Indies. In 1893 he became associated with the City of Newark as assistant engineer of the Department of Streets and Highways, being later elevated through the grades of engineer of track elevation and principal assistant engineer to engineer of the department. He was a member of the American Society of Civil Engineers.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

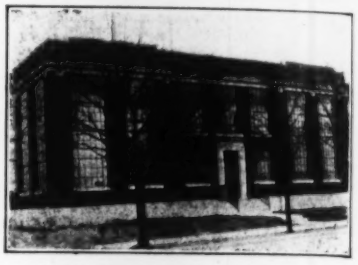
Turbine Maker Installs Hydraulic Laboratory

Equipment Provided for Making Variety of Complete Tests in New $40,000 Brick Structure

BY JOHN S. CARPENTER
Hydraulic Engineer, S. Morgan Smith Co., York, Pa.

TO PROVIDE facilities for testing hydraulic turbines, draft tubes and turbine settings, the S. Morgan Smith Co. of York, Pa., has just completed, at a cost of $40,000, the construction of a modern test flume. Previously the bulk of the testing work had to be carried on at the flume of the Holyoke (Mass.) Water Power Co., but owing to the increasing demands for tests at that place it was often difficult for turbine manufacturers to get work done in time to meet shipping dates. With its new test flume, the S. Morgan Smith Co. is in a position to conduct its testing and research work at its own plant.

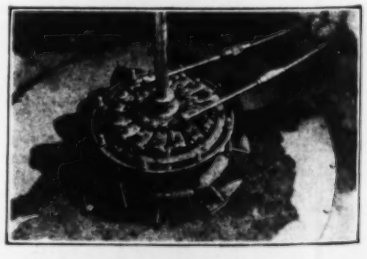
The new hydraulic laboratory, as shown in the accompanying illustration, is a two-story brick structure 24 x 72 ft. in plan. The equipment includes a double suction, 9,000-gal.-per-minute, 50-hp. pump driven by induction motor, giving a maximum head of 12 ft. on the turbine. This pump takes its water under a head from a weir discharge pit and delivers into a baffle chamber



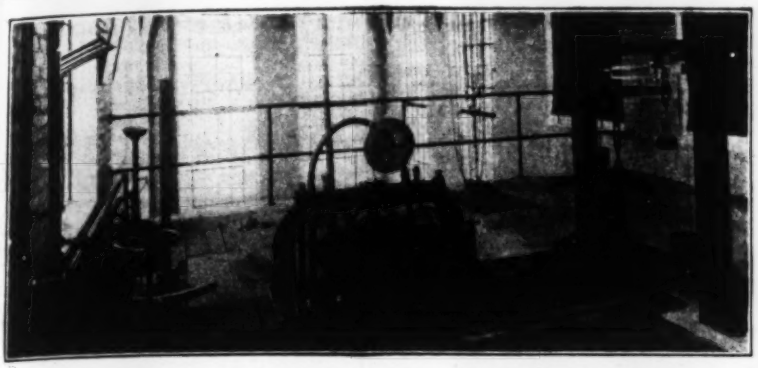
NEW HYDRAULIC LABORATORY OF S. MORGAN SMITH CO.

with an overflow to keep the head constant, the flow passing thence to a head-race tank. A valve is used on the discharge to regulate the overflow. From the turbine discharge the water passes through stilling racks and then over a sharp-crested weir without end contractions and with an edge of planed strip brass. Water passes thence into the pump suction and the cycle begins anew.

On the operating floor are an Alden oil-type hydraulic brake, Fairbanks scales, and gate operating mechanism. Constant water pressure for the brake is obtained from a standpipe. Turbine speeds are taken from a revolution counter similar to that used at Holyoke. The discharge is indicated by a finely graduated hook gage in a stilling tank in the tail-race. The actual and effective head is measured by the difference beween gages in the head and tail-races and can be checked by a direct-reading head-gage. A view of the operating flow is shown on p. 513.



HEAD-RACE PIT WITH TEST TURBINE CASING IN PLACE



OPERATING FLOOR, WITH HYDRAULIC BRAKE, SCALES AND GATE MECHANISM

One of the illustrations shows the floor of the head race pit with test turbine casing in place and gate rigging connected up. The turbine rests on a large cast-iron plate which can be removed if desired. By means of a side opening not shown in the picture horizontal turbine settings also can be tested. A 3-ton hand crane is provided for taking the turbine out of the pit or removing draft tubes.

Regularity in taking readings is provided by a double pendulum electric time clock, which rings every half minute.

The hydraulic laboratory design was prepared by George A. Jessop, of the engineering department of the S. Morgan Smith Co.

First Pipe Made at New Plant

On March 1, the date announced by President J. R. McWane last September, the first pipe was made at the new pressure pipe works of the McWane Cast Iron Pipe Co., Birmingham, Ala., for which the site was acquired last September. The present plant, the first unit of a larger future development, will produce 8,000 ft. of small cast-iron pipe per day. Its 1½-in. iron pipe, the company claims, is the smallest of its kind made. Larger sizes also are manufactured. The pipe is equipped with the McWane precalked joint described in *Engineering News-Record*, Sept. 7, 1922, p. 413.

The McWane company also announces the opening of sales offices in Philadelphia, Birmingham, Dallas, and Los Angeles, with warehouse stocks at other points.

Lumber Standards Committee Fixes Basis of Measurement

The Central Committee on Lumber Standards, Washington, D. C., announced last week through its executive secretary, R. G. Merritt, that at a recent meeting in Chicago it had agreed, by majority vote, to the "rough green" basis of measurement for lumber—that is, measurement of the lumber sawn full size as it falls from the log and not its size when "rough dry."

A study of the most economical and practical thicknesses for standard boards is now being made by the consulting committee on lumber standards. It is agreed that a board should not be 1 in. thick when the purpose for which it is used can be served by a lesser thickness.

Equipment Exported

According to figures given out by the U. S. Department of Commerce, exports of power shovels and other types of construction equipment for December, 1922, were as follows: 1 power shovel, valued at $7,130; 556,500 lb. of dredging machinery valued at $78,193; nine cranes valued at $60,171; 514 hoists and derricks (except mining) valued at $48,808.

The power shovel was shipped to British South Africa. Mexico was the bigger consumer of dredging machinery, and Japan took two cranes at $25,516.

Contractors Outline Program of Co-operation

From the report of the Committee on Methods presented at the annual convention of the Associated General Contractors in Los Angeles, Cal., Jan. 30-Feb. 3.

As a result of the investigation and activities of your Committee on Methods during the past year, the following recommendations are made:

(1) That the Association continue its co-operative work with other associations in formulating standards and simplifying dimensions in the field of materials and equipment production.

(2) That the contact formed with equipment manufacturers during the past year be strengthened, and that the joint work of these agencies be extended to all subjects of mutual interest.

(3) That a meeting be arranged with officials of the income tax unit to establish rational values for the depreciation of construction equipment, and to provide contractors with information to assist them in properly making out their returns.

(4) That the Association continue to improve safety measures in the construction industry and co-operate with the National Safety Council in its investigation and presentation of improved safety methods and devices.

(5) That the Association join with other associations of engineers, architects and manufacturers to further the study of seasonal fluctuation in industry and devise means, as far as possible, for its elimination in both the basic industries of construction and in other lines of production.

Some Neglected Factors in the Care of Equipment

Lack of Cleaning and Lubrication Boosts Power Consumption—Periodic Inspection Important

By Clarence E. Bement
Vice-President and General Manager, Novo Engine Co., Lansing, Mich.

Mr. Bement's organization, which manufactures gasoline engines, pumps, air compressors and hoists for contractors' use, has often been commended for the promptness and completeness of the service rendered to purchasers of its products. One example may be cited:

A contractor ordered some piston rings without specifying size or type. Instead of consuming time in correspondence and keeping a machine idle on the job, the Novo company shipped to him immediately piston rings for ALL *models of its engines, so that the contractor might select those for his particular needs and return the others.*

—EDITOR.

In recent years much publicity has been given the subject of "Service"—meaning that branch of the manufacturer's business treating of proper operation and maintenance of equipment in the field. This extends all the way from such small courtesies as placing a man at the owner's disposal to instruct his operator, to replacing the whole unit if it proves to be unsatisfactory. All manufacturers are alert to the importance of rendering such service in the most efficient and acceptable manner.

Strange to say, the importance of this service is more fully appreciated by the manufacturer than the owner. From the standpoint of a manufacturer of equipment used in the construction industry we find a surprising condition of indifference with respect to the proper operation and maintenance of equipment sold by us, notwithstanding the fact that equipment out of commission becomes a most serious factor of annoyance and expense to the owner. The fact that the purchase of a piece of machinery frequently represents an investment of much money seems to be lost sight of, although its efficient service may mean to the owner the difference between profit and loss on a job.

Why Breaks Occur

Many constructors do not have a mechanic on the job, but entrust the care and adjustment of expensive machinery to untrained men. The result is that bearings and gears break because concrete is allowed to collect day after day; grease cups are broken off and the hole becomes clogged with dirt. Until the final crash comes the power consumed in overcoming the friction in such plants constitutes a large percentage of the total consumption of power—perhaps 50 per cent or more. On top of this is the expense due to the delay while waiting for the arrival of the repair parts that have been ordered.

With few exceptions constructors do not appreciate how anxious the manufacturer is to put his service departments on the most efficient basis or how much depends upon the contractor's own cooperation. This is not fault-finding criticism. The construc-

tor has many problems to solve, and as long as a machine will run at all its proper care seems one of lesser importance.

Lubrication is perhaps the oldest and at the same time one of the most important of all maintenance problems. If a statement representing the expense chargeable to improper lubrication or lack of lubrication could be placed before the individual owners of machinery used in the construction industry, an immediate and far-reaching reform in this phase of the maintenance problem would result.

Repair Parts

In the matter of repair parts, a little foresight on the part of the owner or operator will in most cases eliminate delay and the expense incident thereto. The observance of a few simple rules applicable in all cases would result in a great advantage to both the manufacturer and owner. Care should be exercised in giving complete name, address and point to which parts should be shipped. Complete part number and name of part should be specified, as well as serial number of machine and size, if so designated. If in doubt as to part number and description send in old part properly tagged for identification.

Constructors can save themselves much money by having their equipment thoroughly examined during idle periods, either by their own mechanics or one representing the manufacturer. Worn parts can them be replaced, bearings rebabbitted and everything put in perfect working order. After this has been done the machines should be repainted, all exposed iron and steel surfaces greased, and then placed under cover.

Machinery given such care and attention will long outlive machinery which receives no attention, until it breaks down. The owner will be repaid in the more efficient and longer service to be had from the machine and this benefit is reflected to the manufacturer in the more cordial feeling toward the equipment sold by him.

Business Notes

Alpha Portland Cement Co., Easton, Pa., has purchased the assets and goodwill of the Continental Portland Cement Co., St. Louis, and will continue the business, maintaining offices in St. Louis. It is the intention of the Alpha management to increase the plant's present capacity of 3,200 bbl. daily to from 4,000 to 5,000 bbl. daily.

Rix Compressed Air and Drill Co., San Francisco, announces the opening of its new quarters, a four-story structure at 505 Howard St.

B. Olney Hough, for many years editor of the *American Exporter*, has resigned from that position to establish himself as export consultant to manufacturers, banks and exporters under the name of B. Olney Hough, Inc., 17 Battery Place, New York City. During a business experience of 25 years he has been salesman, both domestic and foreign, manager and buyer for manufacturing plants, and has operated as export merchant in the United States and import merchant in foreign countries. He is the author of the book "Practical Exporting."

Gibb Instrument Co., Bay City, Mich., maker of electric welding equipment, has increased its authorized capital stock from $75,000 to $175,000. Of the increase $40,000 has been sold at par to provide increased manufacturing facilities.

Samuel B. Cochrane, secretary and general manager, Atlas Steel Barrel Corp., Bayonne, N. J., died at his home in Brooklyn, N. Y., Feb. 27. He was 63 years old and became president of the Atlas company 10 years ago.

William C. Wright, sales agent for the Wyoming Shovel Works, Wyoming, Pa., and The L. & I. J. White Co., Buffalo, N. Y., has been appointed sales agent for the Philadelphia district, effective Feb. 1, by the Steacy-Schmidt Manufacturing Co., of York, Pa., manufacturers of kilns, dryers, boilers, stacks, gray iron and semi-steel castings, special machinery and builders of complete lime and hydrating plants.

A. W. Berghoefer has again become associated with the Gifford-Wood Co., manufacturer of elevating and conveying machinery and ice tools, and will be located at the New York office.

R. Van Hoevenberg, formerly general sales manager of the Standard Scale & Supply Co., Pittsburgh, has been appointed general sales manager of the Dravo Equipment Co., with headquarters in Pittsburgh.

Chicago Pneumatic Tool Co., New York, announces the appointment of H. J. Bradley as branch manager, San Francisco, succeeding J. K. Haigh who has been transferred to the Chicago branch to resume sales work.

Laib Co., Louisville, Ky., manufacturer of wrought pipe valves and fittings, has filed articles of charter amendment providing for an increase in capitalization from $150,000 to $900,000. The $750,000 will be raised by the sale of 2,000 shares of preferred stock and issuance of 5,500 shares of common stock at a par value of $100. Part of the 5,500 shares of common stock will be issued as a stock dividend.

Oxweld Acetylene Co., Newark, N. J., announces that its western department has recently moved to larger quarters at 1050 Mission St., San Francisco. Leo Romney, manager of the western department, states that the move was made necessary by the rapidly growing business on the Pacific Coast. At the new location the company occupies the entire building, two stories and basement, 20 x 150 ft., which affords better facilities for the warehousing of surplus stocks of welding and cutting apparatus, for private and general offices and for an apparatus repair service department.

Standard Conveyor Co., North St. Paul, Minn., announces that it has acquired by purchase all the rights, titles and patents pertaining to the Brown Portable Conveying Machinery Co.'s line of portable and sectional piling, elevating, conveying, loading and unloading machinery for the handling of packed and loose materials. This machinery has been manufactured by the Brown company at North Chicago for ten years. Until further notice the plant will be continued in operation by the Standard company.

R. W. Heerlein has assumed the duties of vice-president and general manager of the newly organized Flint Structural Steel Co., Flint, Mich. This organization is affiliated with Massillon (Ohio) Bridge & Structural Co., which recently purchased the Flint plant of the Perkins Structural Steel Co. and has in turn sold it to the Flint company.

Equipment and Materials

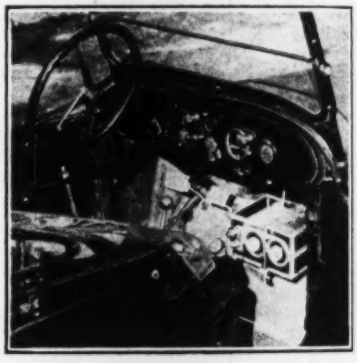
Price Cut on Portable Conveyor

A reduction of about 16 per cent in the price of its Cub portable conveyor for handling sand, stone, and other loose material is announced by the Link-Belt Co., Chicago. The new price is $585 as against $700 previously charged.

The equipment is mounted on two wheels, is driven by a 2-hp. electric motor, has a conveyor belt speed of 250 ft. per minute and a capacity of 45 cu.ft. per minute with uniform feeding. In explanation of its price reduction the company states that the loader has been placed on a quantity production basis, resulting in substantial savings in manufacturing costs.

Recording Device on Auto Shows Condition of Road Surface

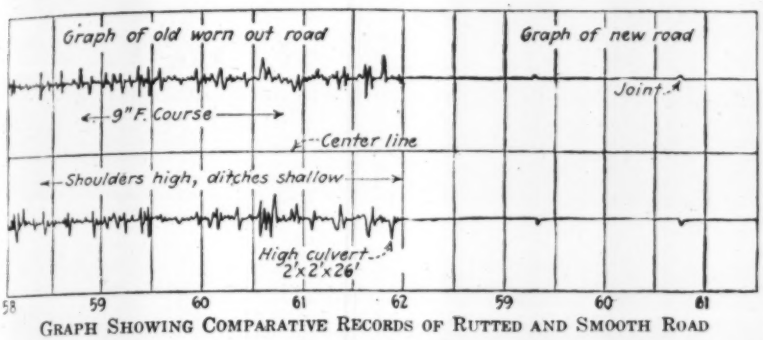
To indicate to highway engineers the condition of road surfaces a recording instrument known as the Vialog, designed for attachment to a passenger automobile or truck, has recently been perfected and placed on the market by the Universal Road Machinery Co., Kingston, N. Y. As shown in the accompanying illustration of an inspection car of the New York State Highway Commission, the device is installed on the dashboard. It is built almost entirely of aluminum and is light and compact.



Dashboard Carries Recording Device

Within the box is a paper chart 6 in. wide driven by a flexible shaft connected to one of the front wheels; two recording pencils are actuated through a connection with the front axle. The paper is furnished in lengths sufficient for the inspection of 11 miles of road. A clutch is provided so that the instrument may be operated or disengaged at will.

As the automobile is driven over the road the chart moves in direct ratio to the distance traveled (the scale is 1 in. to 50 ft. of road) and the recording pencils make a series of irregular or straight lines depending on the condi-



GRAPH SHOWING COMPARATIVE RECORDS OF RUTTED AND SMOOTH ROAD

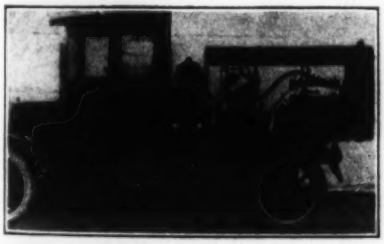
tion of the pavement. In this way the depressions and high spots are located, measured and recorded. The moving paper chart is in plain view of the observer so that notes may be made and topography or structures sketched in as the inspection proceeds.

Irregularities in the pavement are also automatically summed up and may be read at any time. This information may be reduced to inches of irregularities per mile of pavement by a simple calculation, for use in comparing various types of pavement or pavements of the same type on different routes. The device is the invention of Harley Dunbar, an engineer of the New York State Highway Comsion.

Portable Air Compressor Mounted on Ford Truck

A recent development in portable road-building and paving machinery is found in an air compressor mounted on a standard Ford truck which has been introduced by the Ingersoll-Rand Co., New York. The compressor is firmly held down to the truck chassis by means of U-bolts, so that it is unnecessary to drill bolt holes or make other alterations.

The air-compressing plant consists of a two-cylinder, vertical compressor, direct-connected to a four-cylinder, four-cycle, tractor type of gasoline engine; a radiator and fan for cooling the water for both the compressor and engine; an air receiver; fuel tank and other accessories. A regulator is furnished for automatically throwing the load off the compressor when a pre-



determined maximum receiver pressure is reached and throwing the load on the compressor at a predetermined minimum pressure.

With the outfit there are also supplied several tool boxes attached to the steel frame holding the compressor and engine. These are used for holding rock drills and pneumatic tools.

This compressor has a capacity of 91 cu.ft. of free air per minute and will operate a Jackhamer rock drill or two paving breakers, or other pneumatic tools such as are used by contractors and public service companies for road building, tearing up asphalt for pipe trenches, erecting steel structures, or for general maintenance work.

Leather-Waste Flooring Improved by Asphalt Impregnation

An improved feature, in the form of an impregnation with a rock-asphalt composition, has been introduced in the manufacture of the leather-waste inductrial flooring slabs developed by A. C. Denning, of the Endicott-Johnson

Corp., shoe manufacturers, Johnson City, N. Y., and described in *Engineering News-Record* of Nov. 23, 1922, p. 908. This change in the process followed the taking over of the distribution of this product by the James A. Coffey Engineering Corp., New York City manufacturers of Minralite mastic mix, which is employed in treating the ½-in. strips of leather fibre which are built up into 16 x 28-in. laminated sheets ⅜ or ½ in. thick. With the asphaltic treatment adopted the joints between the leather strips are filled and a smoother, more waterproof surface secured than was the case with the untreated leather fibre. The weight of the treated flooring is about 4 lb. per square foot and is being introduced under the trade name "Long Life Fibre Flooring."

The flooring is designed for use in factories, warehouses and offices, and among the advantages claimed for it are: Great durability, as demonstrated by three years' tests at the Endicott-Johnson plant; resiliency, thereby minimizing the fatigue of workers who are on their feet all day; non-slipperiness; fire-resisting qualities; and simplicity of laying. The material furnishes a comparatively noiseless flooring and is recommended for installations where trucking is done.

Water Softening — GRAVER CORP., East Chicago, Ind.,, has issued an 8-p. bulletin on its Zeolite water-softening equipment for industrial and home use.

Publications from the Construction Industry

Elevating Loaders—BARBER-GREENE CO., Aurora, Ill., has published a 32-p. illustrated booklet entitled "Results on Road Jobs." It presents sketches and photographs of a wide variety of material-handling installations together with brief descriptions of each job and records of progress. The latter portion of the booklet is devoted to portable conveyors of the endless belt type.

Backfiller — BUCKEYE TRACTION DITCHER CO., Findlay, Ohio, has published an illustrated booklet describing its Model D backfiller. The machine is mounted on full-length crawler traction and has a boom with a swinging range of 160 deg.

Rail Steel Reinforcement — LACLEDE STEEL CO., St. Louis, has published an attractively printed and illustrated volume of 84 p. on rail steel for concrete reinforcement. Information is given as to the source and manufacture of steel bars, both from rail steel and billets, the various grades of reinforcing steel and the properties peculiar to each. It is the aim of the publication, by presenting a full description of the manufacture, physical properties and use of rail-steel bars, to answer attacks on this product made by distributors of billet bars. The text, however, is technical, not controversial, among the topics discussed being a comparison of the different grades of steel, with particular reference to crystallization, uniformity, brittleness, and bending. The latter portion of the volume is devoted mainly to photographs of structures reinforced with rail steel bars, including large public buildings, office and industrial structures, grain elevators, dams, sewers and other public works, bridges, roads and docks. The text concludes with standard specifications for concrete reinforcement bars.

Centrifugal Pumps — THE ALLIS-CHALMERS MANUFACTURING CO., Milwaukee, has just published a 58-p. illustrated bulletin entitled "Centrifugal Pumps and Centrifugal Pumping Units." The first half of the text deals with the company's standard types of centrifugal pump ranging upward from a size of 1½ in. and a capacity of 150 gal. per minute. Advice is given regarding the application of both single-stage and multi-stage units and the best types of drive under different conditions. Curves of tests are reproduced to show wide ranges of high efficiency with variable speeds. A number of applications of the multi-stage pump to city pumping service, hydraulic elevators, fire service, boiler feed supply, unwatering mines, irrigation, and general industrial use are illustrated and described. The latter portion of the bulletin is devoted to special pumps for unusual services, among them a rubber-lined pump handling liquids containing gritty matter and large horizontal and vertical centrifugal pumps. Several pages are devoted to head-capacity and to friction tables. The bulletin concludes with a valuable chapter of instructions on the installation and operation of horizontal centrifugal pumps.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Why Construction Cost Is High and—Will It Go Higher?

Volume of 1922 Contracts 49 Per Cent Heavier than for 1921—Further Cost Inflation Depends on March-May Awards

A glance at Chart I shows what appears to be a paradox: construction cost rising steadily month after month, while contract volume declines. When prices of building materials were at the minimum, in May, 1922, the volume of large contracts awarded was 79 per cent above 1913. In February, 1923, the cost index had mounted to 197.40, and contracts stood at 105 compared with 100 in 1913. At present the *E. N.-R.* Cost Index registers 205.25, with the trend still upward.

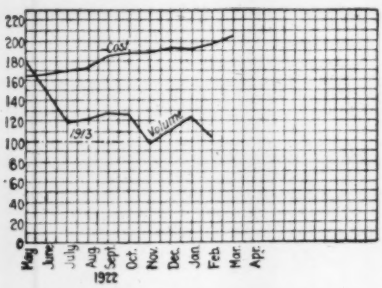


CHART I—PRESENT SITUATION: COST RISING, VOLUME DECLINING

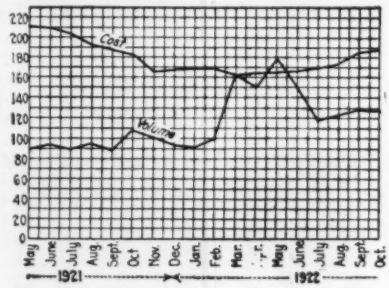


CHART II—CONSTRUCTION COST AND VOLUME SINCE MAY, 1921

Chart II, however, largely explains the anomaly. Cost declined throughout 1921, while contract letting was 8 per cent below the 1913 par. Furthermore, in the last seven months of 1920 the Construction Volume Index (C.V.) averaged 30 per cent below 1913. The lowest cost point occurred in March, 1922, when the general decrease from the peak was 38 per cent. The very next month showed a 3-point increase, and thereafter construction cost began its re-inflation. In March, also, the heavy contract-letting of 1922 began, the C. V. being 162 on the basis of four issues of Construction News. The peak (179) occurred in May. In these three months over half a billion dollars worth of large contracts was awarded. Volume fell off heavily in June and July, but nevertheless has remained consistently above 100, and has thus permitted the maintenance—and even the continued inflation—of cost.

Whether cost will continue to advance and, if so, for how long, will depend very much upon the amount of work placed under contract in the next three months. A C.V. of less than 120 would probably check the rising tide of prices. Indications are that March contracts will considerably exceed those of the previous month. Anything more would be a mere guess.

At present the mill price of structural steel is $2.25@$2.50 per 100 lb., with a decided leaning to the higher figure. Lumber has been steady for the last month, as have brick and lime. In the last few weeks two large cement companies have announced advances.

What It Cost to Build North Carolina Roads

On Feb. 1 the North Carolina State Highway Commission let contracts amounting to $3,030,099. Bids were received from 165 contractors. There were twenty-one projects totaling 193.67 miles, of which 63.68 miles were concrete or asphaltic paving and cost $1,933,937 or about $30,370 per mile. This included grading, draining, bridges, culverts, etc., but did not include the usual 10 per cent for engineering and contingencies. The widths of pavement were about equally divided between 16 and 18 ft.

The remaining 129.99 miles were of sand clay top soil or earth, costing $1,076,290, or about $8,279 per mile, including grading, draining, structures, etc.

The concrete bridges and culverts included in the above figures amounted to $378,877 or $1,956 per mile. Such structures throughout the entire state average about $1,975 for each mile of road built.

There Are 1910 Miles of South Carolina Roads

The total miles of roads under maintenance at the end of 1922 was 1909.72 as compared to 1313.5 at the beginning of the year. The total cost of maintenance work supervised by the department during the year was $474,120.78, of which $382,360.77 was for labor and materials, and $91,760.01 was for the purchase of equipment. The average cost per mile per year was $240.68. In a number of counties the funds were insufficient to take care of the roads completed on the State Highway System, and this condition became worse as the mileage increased during the year. It is estimated that the funds for 1923 will be insufficient in almost one half of the counties.

State Road Programs

Indiana's plans will probably be ready for announcement in two weeks.

Oklahoma reported on Mar. 2 that a bill was pending which provides for 50 per cent of the automobile taxes, which aggregate $3,500,000, to be placed in a state road fund. Another bill provides for a tax of 2c. per gal. on gasoline, and the revenue ($2,500,000) would be placed in the road fund. This state money is to be appropriated to the counties according to their state road mileage, and will be spent for construction and maintenance of state roads, under the direction of the state highway commissioner.

Montana legislature has appropriated $150,000 per year for the two fiscal years beginning July 1, 1923, and July 1, 1924, to be matched with county road funds and Federal Aid on the basis of 15, 32 and 53 per cent, respectively. This will develop $1,000,000 worth of road work for these two years, providing the counties put up $320,000 per year. The present list of projects which are reasonably certain to be constructed with county and state funds matching Federal Aid, and which will probably be placed under contract this year, totals about $650,000.

It is possible that projects on the Federal Aid 7 per cent system, within Indian reservations, totaling $1,200,000, will go under construction this year.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 141 to 159, are the following:

Apartment, Philadelphia, Pa., for L. H. Cahan and Sons, $6,000,000.

Depot, Kansas City, Mo., for Interurban Central Station Co., $3,000,000.

Office building, San Francisco, Calif., for Pacific Gas and Electric Co., $1,500,000.

Pumping station, Milwaukee, Wis., for Commissioner of Public Works, $1,500,000.

Temple, Milwaukee, Wis., for Milwaukee Lodge of Elks, $1,000,000.

Auditorium, Los Angeles, Calif., for Al Malaikah Temple, A.A.O.N.M.S., $1,000,000.

Hotel, Portland, Ore., for P. Wessinger, $1,000,000.

Steel and Sheetpiles Placed for $89 per Ton

Contract price for furnishing and erecting 1,360 tons of structural and 1,920 tons of steel sheetpiling for an addition to the shops of the Interborough Rapid Transit Ry. at Lenox Ave. and 148th St., New York, was $293,888, McClintick-Marshall Co. The engineer's estimate was $292,400.

Heaviest February Steel Ingot Output in Last Two Years

While the February pig-iron output reached a daily average of 106,935 tons, surpassing all previous records for that month and showing the heaviest tonnage reported since March, 1920, the steel ingot production rate fell off 10 per cent from the month preceding.

Steel ingot production totals as reported by the American Iron and Steel Institute show 2,919,017 tons for February as against 3,251,694, in January. Although the January tonnage is the heaviest reported since 1920, the total for February is nearly 30,000 tons greater than any month during the last two years.

STEEL INGOT OUTPUT IN GROSS TONS

	1923	1922	1921
January	3,251,694	1,593,482	2,203,186
February	2,919,017	1,745,022	1,749,477
March	.....	2,370,751	1,570,978

A steady falling off in the production rate characterized the first quarter of 1921 as compared with a gradual gain in output during the corresponding period of 1922. With the steel industry operating at about 90 per cent of capacity as against 80 per cent last month and 55 per cent one year ago, the output for the current month will probably greatly exceed the totals for either January or February.

Bond Market Strong

The bond market, particularly for municipal securities, has continued strong throughout February and well into the first half of the current month. This development is due to the great number of small municipalities taking advantage of the current money market to obtain loans for improvement purposes.

According to the National City Bank of New York, the City of Philadelphia sold $8,000,000 4 per cent bonds, due in 1953, which were taken on a 3.88 per cent basis. Some of the larger municipal issues of the month, also included: $5,000,000, State of Oregon 4s and 4½s, to yield from 4.15 to 4.30 per cent; $5,000,000, State of West Virginia 4s and 4½s, at an average price of 99⅛ and interest; $4,721,000, Cleveland, O., 4½s and 4¾s, to yield from 4.10 to 4.25 per cent.

Several issues of 5 per cent Canadian bonds were offered in the American market at a discount from par. The larger issues included: Montreal, $13,000,000; Quebec, $1,872,000; Vancouver, $725,000 and London, $673,000.

The average price of forty standard bonds listed by the *Wall Street Journal* was 87.95, Feb. 24 as compared with 88.10, January 24 and 86.28 on Feb. 24, 1922.

Of the thirty-seven representative issues listed in the accompanying table, eleven sold at par, twenty-four above and two below par; the yields ranging from 4.05 to 5.44 per cent.

Rates varied from 4¼ to 7 per cent. The single 4¼ issue was located in Connecticut with one at 7 per cent in California. The only issue drawing 5½ per cent was sold in South Carolina, with one each at 5¾ per cent in South Dakota and Oregon. All the 6s were disposed of in Southern states with the exception of one in Oregon. The 4½s were confined to the Middle Atlantic and Middle Western states while the bulk of the 5½s were in the lower Mississippi valley. Securities drawing 5 per cent formed the bulk of the thirty-seven disposals, and were fairly well distributed throughout the country.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 141 to 159, are the following large projects:

Double track railway, 60-mi., California, from Daggett to Bagdad, to Sharp & Fellows, Los Angeles, $3,000,000.

Apartment, Cleveland, O., to Kravitz and Yokelson and E. F. Gibbons Construction Co., $1,500,000.

Hydraulic machinery, Quebec, Canada, to Canadian Allis-Chalmers Co., Ltd., Montreal, $1,500,000.

Telephone exchange, Toronto, Ont., to Jackson-Lewes Construction Co., and Dominion Bridge Co., $1,000,000.

REPRESENTATIVE PUBLIC BOND SALES DURING MARCH, 1923

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Minnesota	Armory building	$146,000	4½	102.477	4.33	Jan. 1, 1923	1938–42	Lane, Piper & Jaffray, Inc., of Minneapolis
County								
Broun, Wis.	Highway improvement	605,000	5	102.93	4.58	Oct. 1, 1921 and Apr. 1, 1923	1923–40	The First Wisconsin Co. and others, of Milwaukee
Burlington, N. J.	Road	134,000	5	102.76	4.42	Apr. 1, 1923	1924–33	Barr Bros. & Co., Inc., New York
Campbell, Tenn.	Road	126,000	6	110.55	5.09	Apr. 1, 1923	1933–49	I. B. Tigrett & Co., Jackson, and others
Chautauqua, N. Y.	Road	250,000	5	103.897	4.20	Apr. 1, 1922	1928–29	Barr Bros. & Co., Inc., and others of New York
Hancock, O.	Road	6,000	5½	100.82	4.92	Mar. 1, 1923	1924	W. L. Slayton & Co., Toledo
Madison, Va.	Road	263,000	6	105.25	....	Feb. 1, 1923	1953	Lewis S. Rosentiel Co., Cincinnati
Martin, Ind.	Road	75,000	4½	100	....	Feb. 10, 1923	1943	First National Bank of Loogootee
Pulaski, Ind.	Gravel road	6,300	5	102.13	4.59	Feb. 26 1923	1924–33	Breed, Elliott & Harrison, Indianapolis
	Road	51,500	5	102.08	4.60			
	Road	7,200	5	102.09	4.60			
	Road	8,000	5	102.10	4.60			
Township								
Alliance City, School Dist., Stark Co., Ohio	School	70,000	5	104.60	4.40	Mar. 1, 1923	1926–48	Jelke-Hood & Co., Chicago
Kansas City School Dist., Jackson Co., Mo.	School	1,000,000	4½	102.81	4.28	Jan. 1, 1923	1943	Harris Trust & Savings Bank of Chicago, and others
Busti Union Free School Dist. No. 1, Chautauqua Co., N. Y.	School	150,000	5	107.229	4.39	Mar. 1, 1923	1928–52	Western Reserve Securities Corp. of Buffalo
Tarquinez School Dist. Contra Costa Co., Calif.	School	240,000	5	102.64	....	Mar. 1, 1923	1924–41	Bank of Pinole
Municipality								
Belgrade, Mont.	Water-works	46,000	5	100	....	Jan. 1, 1923	1943	Belgrade Water Co.
Blackwell, Okla.	Park	50,000	5	100	....	Feb. 3, 1923	1928	City Sinking Fund
Bradentown, Fla.	Street paving	76,000	5	98.28	....	Mar. 1, 1923	Serially	Hanchett Bond Co., Chicago
	Sewer extension	10,000						
Cottage Grove, Ore.	Improvements	13,000	6	104.05	5.44	Dec. 12, 1923	1933	Robertson & Ewing, Portland
Crystal Springs, Miss.	Sewer	15,000	5½	100.81	....	.....	.....	Merchants Bank & Trust Co.
Davenport, Ia.	Paving	250,000	4½	101.99	4.30	Mar. 1, 1923	1924–43	Geo. M. Bechtel & Co., Davenport
Ellis, Kan.	Paving	22,694	5	100	....	May 1, 1922	1923–42	Fidelity National Bank & Trust Co., Kansas City
Elton, La.	Water-works	35,000	5½	100	....	.....	.....	Hibernia Securities Co., Inc., New Orleans
Falls City, Ore.	Electric light plant	15,000	5½	100	....	Feb. 1, 1923	1933–43	Starkey & Hubbs and others of Portland
Fort Smith, Ark.	Paving	150,000	5	99.28	....	Apr. 1, 1923	1924–33	First Nat. Bank of Ft. Smith
Gowanda, N. Y.	Paving	234,000	5	100.08	....	.....	.....	O'Brian, Potter & Co., Buffalo
Highland Park, Mich.	Sewer	135,000	4½	102.30	....	.....	.....	Harris, Small & Lawson, Detroit
Hot Springs, S. D.	Sewer	75,000	5½	100	....	Dec. 1, 1922	1932–42	Ballard & Co., Minneapolis
Liberty, N. Y.	Water-supply	130,000	4½	102.245	4.31	Nov. 1, 1922	1927–52	Sherwood & Merrifield, New York
Mahaska, Kan.	Electric light	12,000	5½	101	....	Nov. 1, 1922	1942	Kansas Securities Co.
New Britain, Conn.	Sewer	100,000	4½	101.639	4.05	Aug. 1, 1922	1923–42	E. H. Rollins & Sons, Boston
Phillipsburgh, N. J.	School	150,000	4½	100.693	4.44	Sept. 30, 1922	1924–50	H. L. Allen & Co., New York
Pine Bluff, N. C.	Water	8,000	6	100	....	Nov. 15, 1922	1925–40	Ralph Page, Aberdeen
Port Chester, N. Y.	Improvements	84,000	5	101.53	4.52	Apr. 1, 1923	1924–32	Sherwood & Merrifield, New York
Rayne La.	Water-works	90,000	6	100.01	....	.....	1953	Caldwell & Co., Nashville
Rowlesburg, W. Va.	Streets	40,000	5	100	....	Sept. 2, 1921	1951	The State of West Virginia
San Jose, Calif.	Improvement	5,158	7	100	....	Jan. 29, 1923	1924–33	Hugh Crummey of San Jose and others
Tippecanoe, Ind.	Road	14,300	5	101.65	4.69	Jan. 6, 1923	1924–33	Meyer-Kiser Bank of Indianapolis
Winnsboro, S. C.	Paving	50,000	5½	100		Nov. 1, 1923	Annually	John W. Catheart

Bituminous coal production reached an estimated average daily output of 1,800,000 tons for the week ending Mar. 10, according to the Geological Survey. Production stood at about the same figure for the week ending Feb. 10, but in the meantime dropped to 1,735,000 tons for the week of Feb. 24. The present rate of output is 33½ per cent above the average for the same week in 1919 and 50 per cent higher than the corresponding period in 1921.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 1; the next, on April 5.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.44	$3.95	+$4.50	+$3.20	$3.45	$3.95	$3.45	$3.80	$3.75
Structural rivets, 100 lb.	4.00	4.60	5.25	3.75	4.00	+5.15	4.75	4.25	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.34	3.85	3.15	+3.10	3.35	3.62½	3.30	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	51%	53%	45%	59½%	55-5%	38%	38.2@46.5%	45%	32.76
Cast-iron pipe, 6 in. and over, ton	56.50	+52.50	57.00	+54.20	+60.50	65.00	57.00	58.00	55.00
Concreting Material:									
Cement without bags, bbl	2.70@2.80	+2.90	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd.	1.00	1.24	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	+ 2.50	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	63.00	+38.00	53.00	60.50	+44.75	51.00	39.00	29.00	95.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	+1.95	2.50	1.50	1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	+13.00	11.00	11.00	17@19	12.00	15.50	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1314	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	+1.02	—1.07	1.16	+1.12	1.13	+1.25	1.09	.86	+1.17
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	.....	.....	.50@.55	.56¼	....	.....
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	.30@.70	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81½c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine casing. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.00). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Steadily advancing mill prices reflected in higher steel warehouse quotations throughout the country. Dallas reports rise of 10c. on structural shapes; Chicago, 15c. on shapes and 3c. on reinforcing bars and Denver 20c. per 100 lb. on structural rivets, during week. Last week similar advances occurred in New York, Minneapolis and San Francisco warehouses.

Mill prices of steel shapes quoted at minimum of $2.35 and maximum of $2.50 per 100 lb. for early deliveries. Plate mills are booked up for next three or four months due to heavy demand; quotations of $2.25 nominal, actual buying at an average of $2.35, with some makers asking $2.50 per 100 lb. Reinforcing bars now $2.25 on regular contract tonnages, but $2.35@$2.50 quoted for prompt deliveries. Basic, bessemer and No. 2 foundry iron higher at Pittsburgh, with growing scarcity of iron and steel scrap. Cast-iron pipe, 6-in., quoted in Atlanta at $52.50 as against $51; in Chicago at $54.20, up from $53.20 and in Minneapolis at $60.50 as compared with $58.50 per ton, one week ago.

Concreting materials firmer as to price. While there have been no changes in New York cement prices during the last week, no quotations are being issued by dealers unless orders can be covered by the mills. Atlanta, however, reports rise of 15c. per bbl. in cement and Dallas, 50 per cu.yd. in crushed stone. Atlanta also quotes advance of 10c. per bbl. in lump lime and $1 per M. on common brick.

Lumber demand, particularly for yellow pine, has not slackened perceptibly and prices hold firm with a stronger tone. Pine timbers advanced $1 per M. ft. in Atlanta and Douglas fir sustained a similar increase in Minneapolis.

Linseed oil rose 1c. in New York, 4c. in Denver, 5c. in Chicago and 15c. per gal. in Montreal, since last week. Atlanta, however, reports drop of 5c. per gal. in 5 bbl. lots. Linseed oil has risen steadily since Jan. 1.

Mines, lumber mills and logging camps in the Seattle district reported operating to capacity; building construction exceeding record established during March of last year. In Denver, seven building trades organizations have filed applications with the State Commission for increases in the wage schedule, to take effect April 1, and amounting to a general rise of $1 per hour.

Wages in the northwest Pacific Coast lumber mills have recently increased approximately 5c. per hr. in virtually all the districts of that section. A general advance of 4.9 per cent in wages of skilled and commmon labor and an increase of 6.4 per cent in the common labor rate alone, is seen in the annual survey of the Southern Pine Association as of Jan. 1, 1923, compared with Jan. 1, 1922.